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Public Health Service
Washington, D. C.

September 1962

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U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service • Division of Radiological Health

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ADVANCE REPORT

Public Health Service

The Public Health Service Pasteurized Milk Network June monthly tabulations for 61 stations show an average iodine–131 concentration of 30 μμc/liter. During March and April the average monthly figures for milk were less than 10 μμc/liter. In May they increased to 20 μμc/liter. Relatively high values were detected in June in several states located generally in the Midwest and Northwest. Monthly average concentrations of more than 20 μμc/liter were noted at 16 stations. Monthly averages greater than 100 μμc/liter occurred at four stations. The monthly average for the station with the highest reported concentrations was 350 μμc/liter.

U.S. Naval Research Laboratory

Results from the May 1962 samples, U.S. Naval Research Laboratory 80th Meridian (West) Sampling Program, indicate the arrival of fresh debris from the Christmas Island tests at Lima, Chacaltaya, Antofagasta, and Santiago. The influx of fresh debris from the Christmas Island area is not apparent in the Northern Hemisphere because of the levels of gross beta activity from the Fall 1961 U.S.S.R. nuclear testing series.

Atomic Energy Commission

The June 13 Nevada Test Site detonation was not fully contained underground. Part of the radioactivity escaped to the atmosphere and was carried north by prevailing winds. Data now available indicate that the highest off-site exposure level was about one-quarter roentgen.

The radioactivity from the detonation drifted north from the Test Site, crossed Nevada Highway 25 in the Queen Summit area, and then crossed State Highway 6 between Lockes and Currant. It moved on north and crossed U.S. Highway 50 west to Ely, widening and losing intensity as it moved.

At the distance of Highway 25 in the Queen Summit area (unpopulated), transient levels of radioactivity rose to a maximum of 160 milliroentgens per hour, and at Nyala (inhabited by about 6 persons) were 100 milliroentgens per hour or below. At both locations, the levels dropped within two to three hours to a few milliroentgens per hour.

The release of June 13 contributed in part to the levels of radioiodine found in the Pacific Northwest during the latter part of June.

Considerably smaller but measurable releases of radioactivity offsite have occurred after four previous underground detonations since underground testing was resumed in September 1961. The detonations involved were those of September 15, 1961; March 5, 1962; April 14, 1962; and May 19, 1962. Barely detectable releases of radioactivity off-site occurred after a few other detonations.

All of the off-site radiation levels have been within limits in use at the Nevada Test Site for the past several years.

In accordance with established procedures for reporting data on environmental radioactivity, data on the first two releases have been published in *Radiological Health Data* (issues of November 1961 and May 1962). Collection and collation of data on the other releases of radioactivity are continuing, and the results will be published in later issues of *Radiological Health Data.*

Food and Drug Administration

The resumption of nuclear weapons testing in the atmosphere on September 1, 1961, is now reflected in recently received Food and Drug Administration reports of increased strontium–90 concentrations in selected raw foods when measured against pre-test surveillance data gathered in 1960 and 1961. Six Southeastern samples of lettuce assayed 54 μμc/kg (range 19–178), and 5 Pacific samples assayed 56 μμc/kg (range 64–126) after September 15, 1961, while 19 country-wide samples assayed 1.8 μμc/kg (range 0.3–4.3) prior to the above date. Eight Middle Atlantic samples of spinach assayed 24 μμc/kg (range 7–34), and 5 Pacific and Southwest samples assayed 86 μμc/kg (range 33–167) after September 15, 1961, while 22 country-wide samples assayed 5.3 μμc/kg (range 2.7–9.2) prior to the above date.

Editor's note: The above information is preliminary and subject to further confirmation. It summarizes recent data submitted to the Radiation Surveillance Center, Division of Radiological Health, Public Health Service.

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SECTION I.—AIR AND PRECIPITATION

Radiation Surveillance Network

April 1962

Division of Radiological Health, Public Health Service

The Public Health Service Radiation Surveillance Network (RSN) was established in 1956 in cooperation with the Atomic Energy Commission to provide a means of promptly determining increases in levels of radioactivity in air and precipitation due to fallout from nuclear weapons tests. Prior to September 1961, the Network consisted of 45 stations. Following the September 1961 resumption of nuclear weapons testing by the U.S.S.R., the Network was expanded over a period of several months to 70 stations (see figure 1).

Air

Measurements of gross beta activity of particulates in surface air are taken because they provide one of the earliest and most sensitive indications of increases of activity in the environment and thus act as an "alert" system. A direct evaluation of biological effects is not possible from these data alone.

Daily 24-hour air samples are collected by a high volume air sampler with a carbon-loaded cellulose dust filter. Field measurements with a portable survey meter enable the station operator to estimate the amount of beta activity of particulates in air at the station five hours afer collection by comparison with a known radioactive source. Each operator then reports his field estimate by telephone to the Division of Radiological Health Radiation Surveillance Center in Washington, D. C. to provide a daily national alert report. The filters are then forwarded to the central laboratory of the Radiation Surveillance Network for a more refined measurement using a thin-window gas flow proportional counter. Samples are counted 3 days after collection and re-counted 7 days later. The Way-Wigner formula ($At^{1.2} =$ constant) is employed to extrapolate to the time of collection.

The average fission-product beta concentrations in surface air during April 1962 are tabulated in table 1 and presented by means of isoconcentration contours in figure 1.

Precipitation

Continuous sampling for total precipitation is conducted at each station on a daily basis using funnels having collection areas of 0.4 square meter (m^2). One-half liter of the collected precipitation is evaporated to dryness, and the residue is forwarded to the laboratory to be counted by the same method used for analyzing the air samples. The April 1962 averages of gross beta activity in precipitation, expressed in micromicrocuries per liter ($\mu\mu c$/

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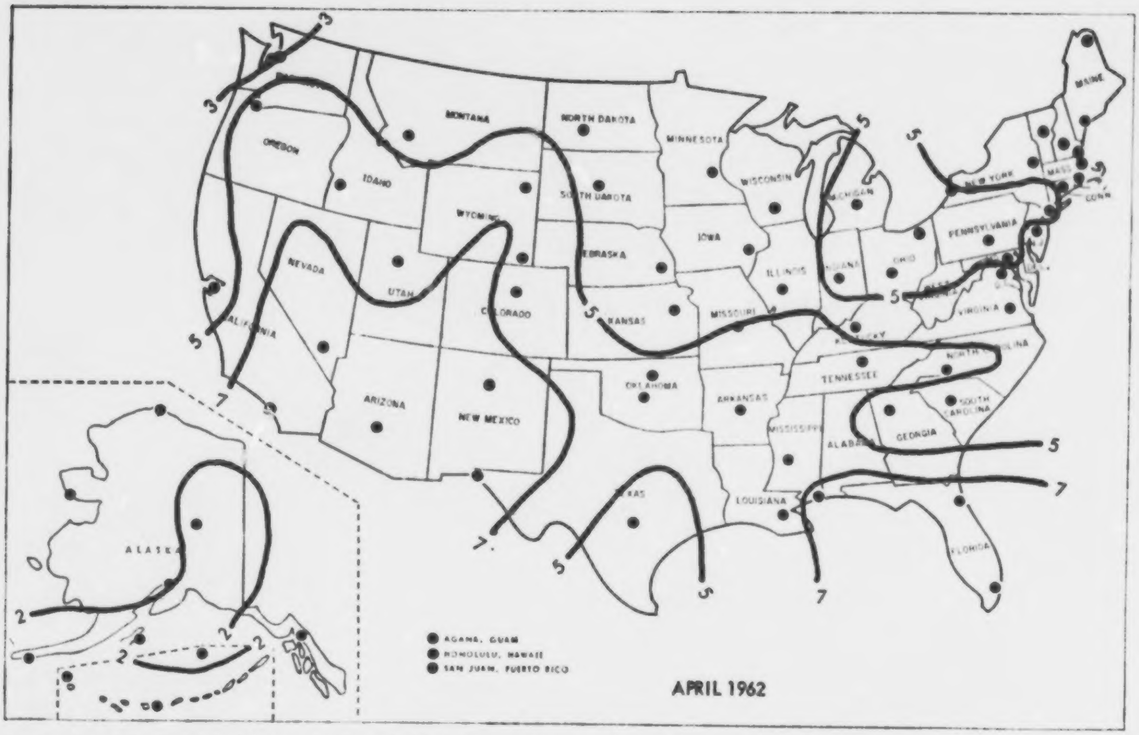

FIGURE 1.—RADIATION SURVEILLANCE NETWORK SAMPLING STATIONS AND AVERAGE FISSION PRODUCT BETA CONCENTRATIONS IN AIR ($\mu\mu c/m^3$), APRIL 1962

liter) and micromicrocuries per square meter ($\mu\mu c/m^2$), are presented in table 2.

When the gross beta concentration of a given daily precipitation sample is too low for reliable measurement, an activity ($\mu\mu c/m^2$) calculated from the minimum level of detection is included in the monthly summation of activity. Placement of a "less than" sign (<) with an average value indicates that the sum of the less than values contributing to the average is 10 percent or more of the total so that the true average is considered significantly less than the number shown.

Profiles

A chronological profile for each RSN sampling station showing the fission product beta monthly average concentrations for the period from April 1956 to December 1960 was published in the July 1961 *RHD*. Beginning with this issue, up-to-date profiles for a group of RSN stations will be presented each month, thus allowing complete network coverage each year.

The format of the profile has been changed considerably from the previous presentation. A cube-root scale was selected for the beta concentrations for several reasons. It allows representation of both low and high concentrations on one scale of limited size. The zero is retained (it is not in a log scale) and serves as a fixed datum. Higher levels are given more emphasis than with a log scale and the lower levels are given more detail than with a linear scale. Finally, the cube root scale provides a visual concept of the magnitude of beta concentrations as illustrated in the legend of figure 2.

Because the monthly detail of the profile up through December 1960 has been published, the new profiles will include such detail for 1961 and 1962 but will show only yearly averages for the years preceding 1961. In some cases the calendar year average is based on only a portion of the year. This is represented by the length and position of the dashed yearly-average line.

TABLE 1.—GROSS BETA ACTIVITY OF PARTICULATES IN AIR, RSN, APRIL 1962

[Concentrations in $\mu\mu c/m^3$]

City	State	Number samples	Maximum	Minimum	Average[a]
Adak	Alaska	23	7.1	0.18	2.4
Anchorage	Alaska	23	3.9	0.54	2.0
Attu	Alaska	20	9.5	0.17	2.6
Cold Bay	Alaska	22	6.8	<0.10	2.8
Fairbanks	Alaska	23	3.9	0.38	2.3
Juneau	Alaska	20	6.3	0.44	1.7
Kodiak	Alaska	23	4.4	0.24	2.1
Nome	Alaska	22	3.6	0.15	1.6
Point Barrow	Alaska	22	3.0	0.61	1.8
St. Paul Island	Alaska	27	5.5	0.36	1.9
Phoenix	Ariz	21	19	3.0	9.8
Little Rock	Ark	23	14	2.3	6.1
Berkeley	Calif	23	12	0.62	4.2
Los Angeles	Calif	22	16	2.8	7.6
Denver	Colo	22	8.9	3.4	6.4
Hartford	Conn	24	7.1	1.8	4.5
Washington	D. C	28	9.3	0.82	4.2
Jacksonville	Fla	23	12	2.6	8.0
Miami	Fla	23	16	1.8	7.2
Atlanta	Ga	17	5.8	1.5	3.6
Agana	Guam	17	6.3	0.83	2.5
Honolulu	Hawaii	22	9.[illegible]	0.64	2.4
Boise	Idaho	23	12	2.3	6.0
Springfield	Ill	21	8.7	1.8	4.7
Indianapolis	Ind	21	12	1.9	5.3
Iowa City	Iowa	23	6.6	1.3	3.8
Topeka	Kans	23	8.4	0.63	4.7
Frankfort	Ky	23	7.4	1.9	4.2
New Orleans	La	22	13	1.5	6.2
Augusta	Maine	21	8.4	0.96	4.0
Presque Isle	Maine	22	7.3	0.42	3.6
Baltimore	Md	22	9.1	1.3	6.0
Lawrence	Mass	22	6.9	1.4	3.9
Winchester	Mass	22	7.5	1.3	4.3
Lansing	Mich	30	13	1.3	6.1
Minneapolis	Minn	22	6.4	0.68	3.5
Jackson	Miss	19	11	1.8	6.1
Pascagoula	Miss	20	14	1.9	7.5
Jefferson City	Mo	22	8.7	2.6	5.0
Helena	Mont	23	8.6	1.2	4.6
Lincoln	Nebr	20	6.3	0.66	4.1
Las Vegas	Nev	17	17	4.8	9.9
Concord	N. H	6	5.2	3.7	4.4
Trenton	N. J	24	6.3	0.70	3.9
Santa Fe	N. Mex	21	21	3.5	8.5
Albany	N. Y	23	8.8	2.1	4.9
Buffalo	N. Y	22	8.5	2.3	5.0
New York	N. Y	14	12	2.6	6.5
Gastonia	N. Y	22	9.1	2.1	6.5
Bismarck	N. D	22	7.0	1.9	3.9
Columbus	Ohio	23	12	1.8	5.4
Painesville	Ohio	6	8.0	4.0	6.5
Oklahoma City	Okla	23	10	2.7	5.9
Ponca City	Okla	25	4.4	1.7	2.8
Portland	Oreg	23	17	1.2	5.6
Harrisburg	Pa	20	8.9	0.56	5.1
San Juan	P. R	[b]—	—	—	—
Providence	R. I	21	8.3	1.8	4.9
Columbia	S. C	21	6.6	1.6	4.6
Pierre	S. D	29	7.2	1.8	3.8
Nashville	Tenn	19	13	0.98	5.7
Austin	Texas	22	9.9	0.51	4.5
El Paso	Texas	23	11	4.2	7.9
Salt Lake City	Utah	23	10	3.1	6.0
Barre	Vt	17	9.2	0.82	4.9
Richmond	Va	22	6.4	2.3	4.1
Seattle	Wash	24	9.0	0.51	2.8
Madison	Wis	23	7.7	0.27	4.0
Cheyenne	Wyo	22	8.1	2.9	6.3
Sundance	Wyo	18	10	0.85	6.6
Network average					4.81

[a] Weighted average obtained by summing the products of individual sampling times and the corresponding activities, and dividing by the summation of the individual sampling times.

[b] Dash denotes no data received.

TABLE 2.—GROSS BETA ACTIVITY IN PRECIPITATION, RSN, APRIL 1962

Station location		Average concentration ($\mu\mu c$/liter)	Total activity ($\mu\mu c/m^2$)
City	State		
Adak	Alaska	[a]—	—
Anchorage	Alaska	6[illegible]	1,100
Attu	Alaska	—	—
Cold Bay	Alaska	—	—
Fairbanks	Alaska	1,500	14,000
Juneau	Alaska	930	75,000
Kodiak	Alaska	—	—
Nome	Alaska	—	—
Point Barrow	Alaska	—	—
St. Paul Island	Alaska	—	—
Phoenix	Ariz	—	—
Little Rock	Ark	1,200	96,000
Berkeley	Calif	3,400	20,000
Los Angeles	Calif	—	—
Denver	Colo	870	15,000
Hartford	Conn	2,800	140,000
Washington	D. C	1,300	100,000
Jacksonville	Fla	1,300	43,000
Atlanta	Ga	710	110,000
Agana	Guam	—	—
Honolulu	Hawaii	520	11,000
Boise	Idaho	420	12,000
Springfield	Ill	—	—
Indianapolis	Ind	1,500	30,000
Iowa City	Iowa	2,400	83,000
Topeka	Kans	3,000	79,000
Frankfort	Ky	810	45,000
New Orleans	La	1,800	150,000
Augusta	Maine	1,300	120,000
Presque Isle	Maine	—	—
Baltimore	Md	700	7,000
Lawrence	Mass	1,300	76,000
Winchester	Mass	—	—
Lansing	Mich	1,800	45,000
Minneapolis	Minn	1,900	48,000
Jackson	Miss	410	89,000
Pascagoula	Miss	—	—
Jefferson City	Mo	4,000	72,000
Helena	Mont	3,100	20,000
Lincoln	Nebr	2,700	29,000
Las Vegas	Nev	—	—
Concord	N. H	—	—
Trenton	N. J	1,000	7,200
Santa Fe	N. Mex	11,000	45,000
Albany	N. Y	700	30,000
Buffalo	N. Y	—	—
New York	N. Y	—	—
Gastonia	N. C	750	120,000
Bismarck	N. Dak	3,200	16,000
Columbus	Ohio	2,800	110,000
Painesville	Ohio	—	—
Oklahoma City	Okla	470	16,000
Ponca City	Okla	1,600	44,000
Portland	Oreg	870	24,000
Harrisburg	Pa	1,800	74,000
San Juan	P. R	—	—
Providence	R. I	1,800	150,000
Columbia	S. C	1,200	110,000
Pierre	S. Dak	1,500	8,100
Nashville	Tenn	1,200	200,000
Austin	Tex	1,000	90,000
El Paso	Tex	—	—
Salt Lake City	Utah	1,800	99,000
Barre	Vt	—	—
Richmond	Va	1,000	130,000
Seattle	Wash	1,400	29,000
Madison	Wis	2,000	55,000
Cheyenne	Wyo	1,900	23,000
Sundance	Wyo	—	—

[a] Dash denotes no sample received.

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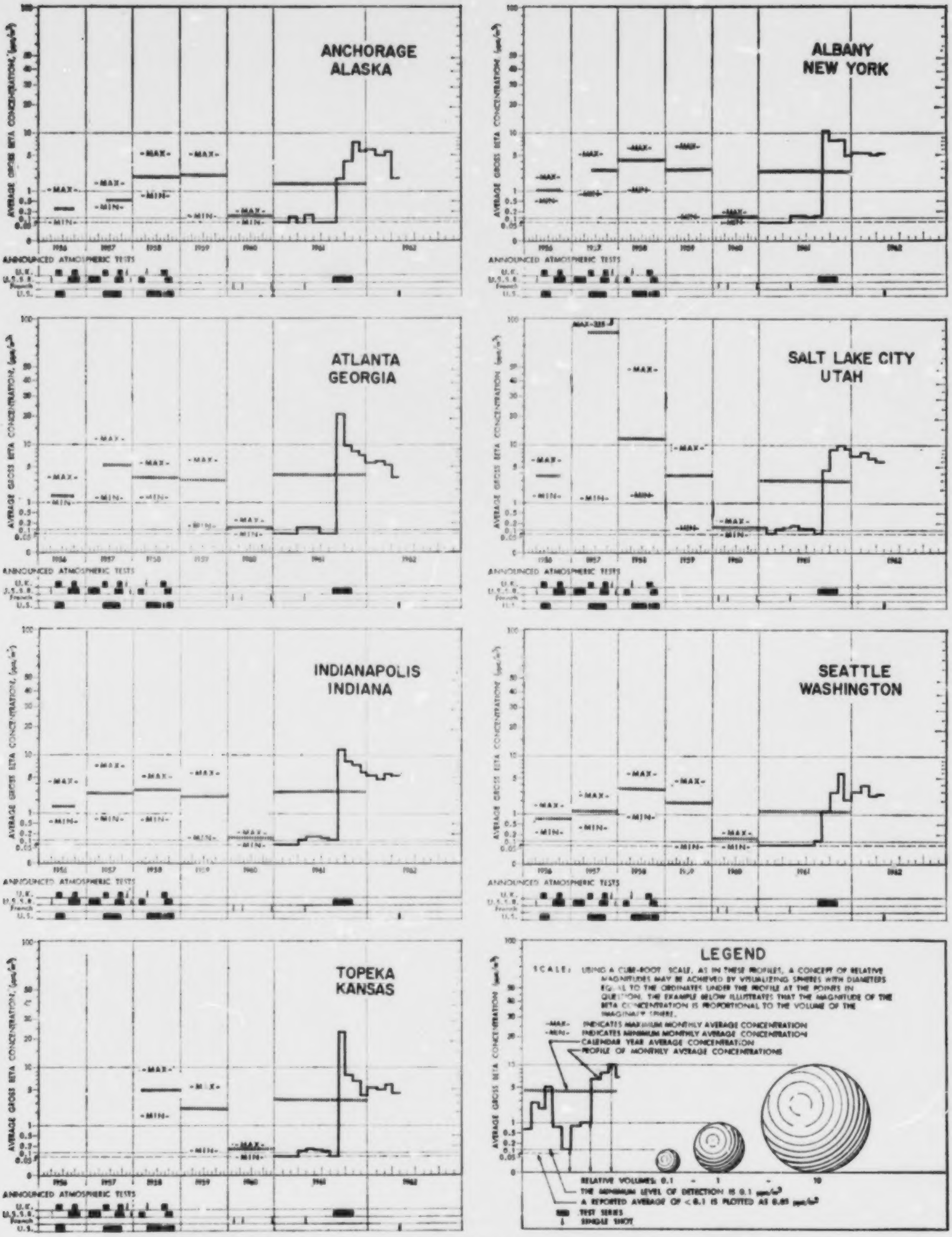

FIGURE 2.—YEARLY PROFILES OF BETA ACTIVITY IN AIR, RADIATION SURVEILLANCE NETWORK, 1956–APRIL 1962

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Surface Air Radon, Thoron, and Fission Product Gross Beta Concentrations At Cincinnati, Ohio

March 26–April 20, 1962

Division of Radiological Health, Public Health Service

The determination of natural background radiation in our atmosphere is useful because the exposure levels from natural radiation can be used as a base for comparative evaluations of exposures from artificially produced radionuclides. Natural radioactivity in surface air is attributed to a number of unstable nuclides other than those produced by man. The earth's crust contains trace amounts of uranium and thorium that occur naturally and which decay through a series of their daughter products. These decay products of uranium and thorium are introduced into surface air through their rare gas daughters, radon (radon–222) and thoron (radon–220), which in turn continue to decay through the uranium and thorium series, respectively. The radon and thoron content of air depends on the escape of these rare radioactive gases from the earth. Concentrations depend on prevailing atmospheric conditions such as ambient temperature, humidity, and pressure, and on soil conditions such as moisture, porosity, and temperature.

Most of the natural radioactivity in surface air is due to radon and its daughters. Thoron and its daughters contribute much less because of thoron's short half-life and hence, a lower effective diffusion rate from the soil.

Radiological Health Research Activities, Research Branch, Division of Radiological Health, Public Health Service, performs a continuous daily sampling program at Cincinnati for radon, thoron, and gross beta fission product concentrations in surface air. The airborne particulates, which include the daughter products of radon and thoron, are collected continuously on a membrane filter surface at a rate of approximately 1.2 cubic meters of air per hour.

Radon–222 concentrations are determined from alpha measurements made immediately after the sampling period (24 to 72 hours) has ceased. Radon–222 (a.m.) concentrations have been corrected for any radon–220 daughter interferences. Radon–222 (p.m.) concentrations are derived from alpha measurements made in the afternoon (3 p.m.) approximately 7 hours after the new sampling period has begun. These values are from the same filters that are counted at 8 a.m. the following day. Radon–222 (p.m.) concentrations are uncorrected for any radon–220 daughter interferences. Radon–220 concentrations are determined from alpha measurements made on the sample used to evaluate the corrected radon–222 (a.m.) concentrations, but are counted 7 hours after the sampling period has ceased. Reported values are corrected to the time of removal of the filter. The gross beta activity of airborne particulates, when measured several days after sample collection, is due principally to artificially-produced fission products.

TABLE 1.—SURFACE AIR RADON (Rn^{222}), THORON (Rn^{220}), AND FISSION PRODUCT BETA CONCENTRATIONS, AT CINCINNATI, OHIO, MARCH 26–APRIL 20, 1962

End of sampling period	Rn^{222} 8 a.m. (μμc/m³)	Rn^{222} 3 p.m. (μμc/m³)	Rn^{220} (μμc/m³)	Beta activity (μμc/m³)
March 26	100	90	1.4	9.65
27	480	60	2.8	15.10
28	630	90	5.1	14.59
29	200	80	3.2	14.98
30	240	120	2.2	15.17
April 2	110	30	0.8	5.36
3	120	40	1.1	10.12
4	110	90	3.4	7.70
5	480	110	4.1	13.27
6	140	110	1.7	16.51
9	90	30	1.4	9.27
10	210	40	2.7	3.99
11	70	100	1.2	6.54
12	290	160	2.7	7.39
13	100	60	1.4	3.49
16	160	50	2.2	7.86
17	600	60	5.7	10.09
18	210	50	3.1	10.18
19	170	50	4.1	4.18
20	140	60	2.7	4.20
Average	197	67	2.3	9.07
Range of counting errors (2σ):				
Maximum	44	22	0.8	0.24
Minimum	15	9	0.3	0.08

The data are computed by an electronic data processing system which is programmed for thirteen four-week periods per calendar year. The data for the period March 26–April 20, 1962 appear in table 1.

REFERENCE

Setter, L. R. and G. I. Coats "The Determination of Airborne Radioactivity," *American Industrial Hygiene Association Journal, 22:* 64–69 (Feb. 1961).

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Radioactivity Measurements In Surface Air Near The 80th Meridian (West)

March 1962

U.S. Naval Research Laboratory

Radioactivity measurements of surface air samples collected at various sites near the 80th Meridian (West) have been made since 1956. Sampling locations are shown in figure 1. This program is operated by the U. S. Naval Research Laboratory (NRL) with the cooperation of interested agencies of the United States, Canada, Ecuador, Peru, Bolivia, and Chile, which make the actual sample collections and forward them to NRL for analysis. Partial financial support of this program is provided by the Division of Biology and Medicine, U.S. Atomic Energy Commission.

The sampling procedure involves drawing air continuously for a seven-day period at a rate of approximately 1200 cubic meters per day through high efficiency filters, 8 inches in diameter, using positive displacement blowers. After a sample is removed, it is forwarded immediately to NRL for assay of gross beta activity two weeks after collection.

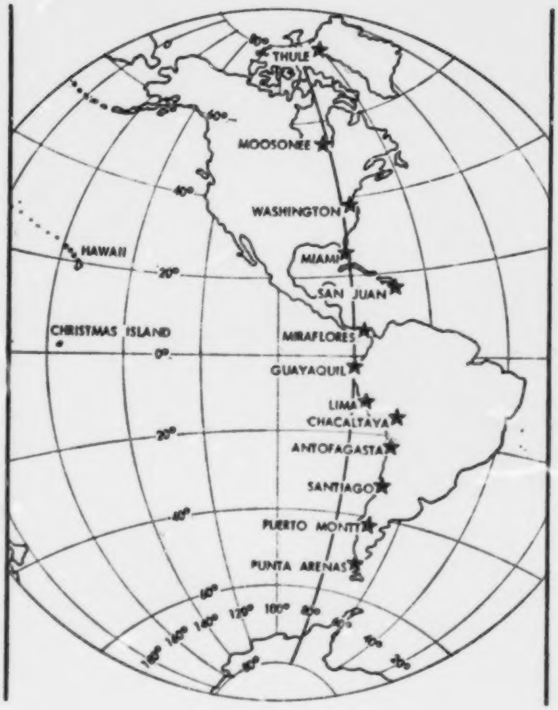

FIGURE 1.(*right*)—ATMOSPHERIC RADIOACTIVITY SAMPLING STATIONS NEAR THE 80TH MERIDIAN (WEST)

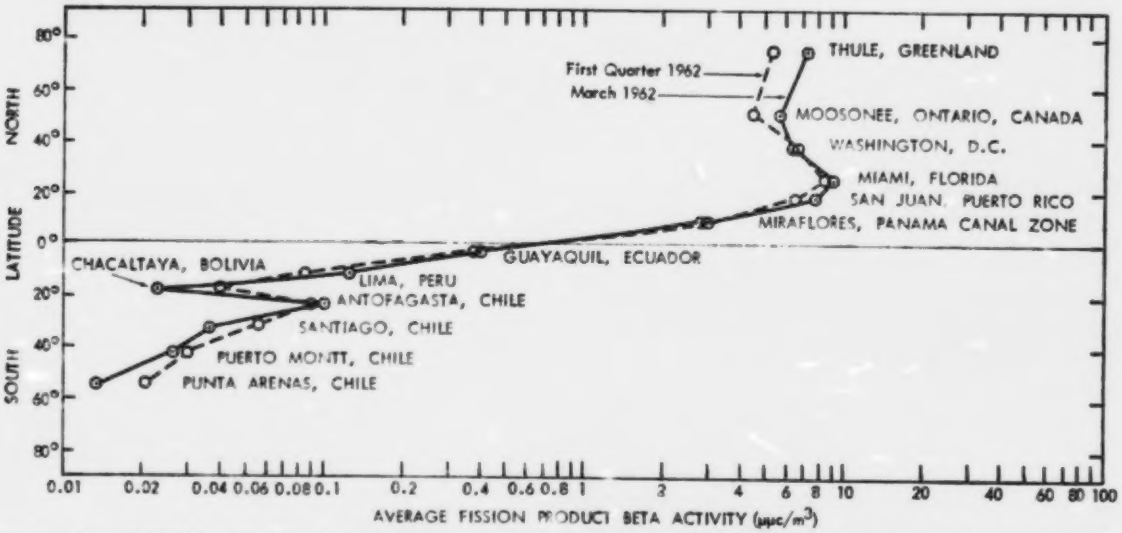

FIGURE 2.—PROFILE OF BETA ACTIVITY, AVERAGE MEASUREMENT OF SURFACE AIR AT STATIONS NEAR THE 80TH MERIDIAN (WEST), MARCH 1962

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TABLE 1.—FISSION PRODUCT GROSS BETA ACTIVITY IN SURFACE AIR, MARCH 1962, NRL[a]

[Average concentrations in $\mu\mu c/m^3$]

Day	Punta Arenas, Chile	Puerto Montt, Chile	Santiago, Chile	Antofagasta, Chile	Chacaltaya, Bolivia	Lima, Peru	Guayaquil, Ecuador	Miraflores, Panama Canal Zone	San Juan, P. R.	Mauna Loa, Hawaii[b]	Miami, Florida	Washington, D. C.	Moosonee, Ontario, Canada	Thule, Greenland
1	0.028	0.026	0.028	0.137	0.034	0.109	0.698	2.68	7.30	6.08	4.34	5.85	5.54	8.38
2														
3														
4														
5														
6	0.011	0.032	0.047		[c]—	0.144	0.318	3.86	10.3	6.85	10.3	3.21	5.18	
7				0.147										9.69
8														
9														
10					0.026									
11														
12														
13	0.008	0.020	0.033	0.079	0.027	0.193	0.304	2.59	9.53	5.00	11.3	5.36	7.34	
14														9.73
15														
16														
17														
18														
19														
20	0.013	0.030	0.034	0.073	0.017	0.077	0.518	1.92	5.90	3.68	7.79	7.66	5.72	
21														2.78
22														
23														
24														
25														
26														
27	0.014	0.030	0.039	0.068	0.014	0.098	0.158	3.20	6.08	8.92	10.5	11.0	4.78	
28														4.60
29														
30														
31														
Weighted average	0.014	0.027	0.037	0.100	0.023	0.127	0.396	2.84	7.93	5.95	9.01	6.40	5.77	7.21

[a] The average concentration determined from a given sample is placed at the center of a rectangle which indicates the length and dates of the sampling period. Station averages for the month were determined by weighting the sample averages according to the number of days in the sampling period or that portion of the sampling period occurring in March 1962.

[b] Mauna Loa data has been included for comparison with Chacaltaya, Bolivia. Both are high elevation stations (3400 and 5200 meters) and about equally distant north and south of the equator.

[c] Dash indicates sample was not received.

The fission product concentrations in air during March 1962 are presented in table 1, and the radioactivity profile along the 80th Meridian (West) for the same month is shown in figure 2. Radioactivity concentrations in the Northern Hemisphere are not appreciably different from those existing in March 1959 during a similar period of heavy stratospheric fallout of debris from the U.S.S.R. Arctic tests. There is clear evidence that some of the radioactivity from Arctic tests does pass into the Southern Hemisphere; however, activity levels there were less than in 1959 because, as of March 1962, there had been no contribution of debris from U.S. tests since held in the tropical regions of the Pacific Ocean.

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National Air Sampling Network
First Quarter 1962

Division of Air Pollution, Public Health Service

The Public Health Service developed its National Air Sampling Network in 1953 to secure basic data on the nature and extent of air pollution throughout the United States, and to detect trends in levels of pollution with respect to time, location, population density, climate, and other factors associated with air quality.

The current basic network consists of 103 sampling stations operating every year in 66 large cities and 37 nonurban areas. In addition to these every-year stations, 126 cities have stations which operate every other year. Thus, there are 229 sampling stations in all, of which about 166 are active in any given year. A list of National Air Sampling Network Stations appeared in the May 1960 issue of *Radiological Health Data.*

The network stations are manned by cooperating Federal, State, and local agencies. Twenty-four hour samples of suspended particulate matter representing approximately 2000 cubic meters of air are collected on glass fiber filters on a bi-weekly random sampling schedule. The analyses of these samples include the measurement of total quantity of suspended particulate matter, the organic matter soluble in benzene, and gross beta radioactivity. Selected samples are analyzed also for nitrates and sulfates, and for a number of metals.

Gross Beta Activity in Air

Gross beta activity data by states, for the years 1953 through 1958, were submitted by the Division of Radiological Health, Public Health Service, in testimony before the Joint Committee on Atomic Energy Hearing on Fallout from Nuclear Weapons Tests (V), Volume I, May 1959, pages 173–185. Subsequent data have been published quarterly in *Radiological Health Data* beginning with the October 1960 issue. First quarter 1962 data are presented in table 1.

Gross Beta Activity In Precipitation

During 1959 a precipitation collection and analysis program was established by the Weather Bureau Research Station in Cincinnati, Ohio, and the National Air Sampling Network. The collection stations are located at Weather Bureau offices or airport stations. Monthly composite samples of precipitation are collected at 30 stations (see figure 1) and forwarded to the Network laboratory for analysis. A list of these precipitation collection stations is given below. Samples are analyzed for total solids and a large number of metals and nonmetals. In addition, samples representing 85 percent or more of the total precipitation recorded at the collecting stations are analyzed for fission product gross beta radioactivity if a large enough volume remains after the requirements for the chemical analysis have been met. First quarter 1962 data are presented in table 2.

REFERENCE

Setter, L. R., Zimmer, C. E., Licking, D. S., and Tabor, E. C., "Air-Borne Particulate Beta Radioactivity Measurements of the National Air Sampling Network, 1953–1959," *American Industrial Hygiene Association Journal, 22:* 192–200 (June 1961).

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Table 1.—FISSION PRODUCT GROSS BETA ACTIVITY IN SURFACE AIR, NASN, FIRST QUARTER 1962

[Concentrations in $\mu\mu c/m^3$]

Station location		Number of samples	Minimum	Maximum	Average
City or county	State				
Birmingham	Ala	7	3.8	13.0	8.4
Mobile	Ala	7	2.3	16.6	7.9
Anchorage	Alaska	6	3.1	11.1	7.3
Pt. Woronzof	Alaska*	6	6.3	17.6	9.3
Grank Canyon Pk.	Ariz*	7	3.8	23.8	13.5
Maricopa Co.	Ariz*	7	7.5	20.1	13.7
Phoenix	Ariz	6	9.0	21.6	15.6
Tucson	Ariz	7	8.8	18.0	13.6
Little Rock	Ark	6	5.2	15.6	7.5
Montgomery Co	Ark*	5	1.7	15.6	7.8
Burbank	Calif	2	4.4	5.9	5.2
Fresno	Calif	7	4.1	23.3	8.6
Humboldt County	Calif*	6	1.3	9.7	5.4
Los Angeles	Calif	5	4.5	17.0	10.4
Oakland	Calif	7	1.4	11.2	6.1
Pasadena	Calif	6	4.2	14.2	9.5
Richmond	Calif	5	2.6	11.5	6.2
Sacramento	Calif	7	2.8	19.6	7.8
San Diego	Calif	6	4.6	15.6	9.7
San Francisco	Calif	7	3.6	25.5	11.7
Santa Barbara	Calif	6	5.5	21.4	11.3
Denver	Col	5	1.2	9.7	5.5
Montezuma County	Col*	7	7.8	17.2	10.8
Bridgeport	Conn	7	3.3	13.3	7.1
Hartford	Conn	7	4.1	10.3	7.5
New Haven	Conn	7	.9	9.1	5.8
Stamford	Conn	7	3.1	9.5	7.1
Kent County	Del*	4	1.9	13.3	7.4
Wilmington	Del	5	.8	6.9	4.9
Washington	D. C	6	3.2	12.0	7.0
Florida Keys	Fla*	7	4.2	9.4	7.1
Jacksonville	Fla	7	3.3	11.8	7.2
St. Petersburg	Fla	3	2.5	13.2	9.1
Tampa	Fla	6	6.0	14.1	10.2
Atlanta	Ga	7	2.0	10.8	6.2
Columbus	Ga	7	3.0	15.1	8.8
Macon	Ga	6	4.4	14.2	8.0
Honolulu	Hawaii	7	3.2	9.6	6.3
Kahaluu	Hawaii*	7	1.7	11.3	4.4
Boise	Idaho	7	2.5	11.1	6.1
Butte County	Idaho*	4	3.7	11.8	8.2
Chicago	Ill	6	4.6	9.1	6.1
Cicero	Ill	7	4.0	10.4	6.6
Peoria	Ill	7	4.0	9.3	7.1
Springfield	Ill	6	5.3	9.2	7.2
East Chicago	Ind	5	4.2	6.5	5.4
Evansville	Ind	6	3.0	10.1	6.0
Fort Wayne	Ind	5	2.0	7.1	5.8
Gary	Ind	7	3.8	9.5	6.7
Indianapolis	Ind	7	7.3	12.7	8.6
Montgomery Co	Ind*	7	6.4	10.6	8.4
Clayton County	Iowa*	6	5.1	11.0	8.0
Des Moines	Iowa	6	2.5	9.7	6.0
Kansas City	Kansas	7	1.4	10.8	6.0
Wichita	Kansas	6	3.7	16.1	8.4
Louisville	Ky	5	4.7	13.8	8.3
Baton Rouge	La	6	5.2	25.7	13.2
Lake Charles	La	7	2.3	12.6	7.3
New Orleans	La	7	2.8	11.0	6.8
Acadia Nat Pk	Maine*	7	2.7	13.9	8.1
Portland	Maine	6	3.3	11.1	6.7
Baltimore	Md	7	.9	9.8	5.2
Calvert County	Md*	6	5.8	11.8	8.3
Boston	Mass	6	1.1	15.2	8.7
Fall River	Mass	5	3.6	11.6	7.8
Lawrence	Mass	7	4.5	[illegible]	8.9
Lynn	Mass	7	1.3	[illegible]	6.2
Quincy	Mass	5	7.2	[illegible]	10.8
Somerville	Mass	7	5.7	[illegible]	10.8
Springfield	Mass	7	1.4	11.5	5.9
Detroit	Mich	6	1.8	12.1	6.1
Grand Rapids	Mich	5	3.5	9.2	6.0
Kalamazoo	Mich	7	4.5	14.6	8.4
Lansing	Mich	7	3.9	11.0	7.2
Saginaw	Mich	7	3.2	8.6	6.1
Minneapolis	Minn	7	3.0	12.3	7.0
St. Paul	Minn	6	4.0	11.7	6.8
Jackson	Miss	7	4.9	12.8	8.5
Jackson County	Miss*	6	2.8	15.4	8.1
Kansas City	Mo	7	1.4	8.8	6.4
Shannon County	Mo*	6	8.3	14.2	11.5
St Louis	Mo	6	3.5	10.5	6.9
Glacier Nat Pk	Mont*	7	1.4	13.6	6.4
Helena	Mont	6	2.4	11.0	7.0
Lincoln	Neb	6	5.5	13.2	7.9
Omaha	Neb	7	1.9	9.6	6.3
Thomas County	Neb*	6	6.0	16.0	10.1
Las Vegas	Nev	6	7.1	26.0	15.1
White Pine Co	Nev*	6	4.3	12.1	8.7
Coos County	N. H*	6	4.5	10.0	6.1
Manchester	N. H	1	1.8	1.8	1.8
Camden	N. J	7	3.2	12.7	8.3
East Orange	N. J	6	4.0	9.3	6.0
Elizabeth	N. J	5	1.4	10.6	6.3
Newark	N. J	7	3.7	10.0	6.4
Trenton	N. J	6	1.5	12.8	8.6
Albuquerque	N. M	5	5.1	15.7	9.6
Colfax County	N. M*	6	3.1	16.5	8.5
Cape Vincent	N. Y*	6	5.5	12.8	7.7
Elmira	N. Y	7	2.8	17.7	6.7
Glen Cove	N. Y	4	7.3	25.2	14.1
Massena	N. Y	7	3.1	10.9	6.5
Mt. Vernon	N. Y	7	5.1	12.1	8.7
New Rochelle	N. Y	5	4.8	11.1	7.8
New York	N. Y	6	1.8	11.9	6.4
Rochester	N. Y	7	4.7	14.1	9.0
Troy	N. Y	5	4.4	20.4	11.8
Asheville	N. C	7	2.7	11.1	8.7
Cape Hatteras	N. C*	6	5.1	13.7	9.8
Charlotte	N. C	7	4.7	12.1	8.6
Winston Salem	N. C	7	2.2	14.7	8.7
Bismarck	N. D	6	3.7	8.4	5.8
Ward County	N. D*	7	3.7	9.6	5.9
Akron	Ohio	7	1.6	12.2	6.7
Cincinnati	Ohio	7	1.9	9.1	5.3
Cleveland	Ohio	5	4.6	14.0	8.2
Columbus	Ohio	7	4.9	20.5	10.7
Dayton	Ohio	7	1.6	6.9	4.1
Lorain	Ohio	6	5.0	11.6	8.4
Springfield	Ohio	6	4.1	8.7	[illegible]
Toledo	Ohio	6	3.0	10.7	[illegible]
Youngstown	Ohio	6	3.2	10.4	6.8
Cherokee County	Okla*	7	4.2	13.1	8.7
Oklahoma City	Okla	3	5.9	8.5	7.3
Tulsa	Okla	6	2.6	8.2	6.4
Curry County	Oreg*	3	3.9	7.2	5.2
Portland	Oreg	6	3.0	16.2	7.6
Clarion County	Pa*	6	4.6	12.6	7.9
Harrisburg	Pa	5	.3	10.6	6.1
Lancaster	Pa	7	1.9	11.7	8.0
Philadelphia	Pa	5	.6	9.7	6.0
Pittsburgh	Pa	7	4.8	10.7	7.3
Reading	Pa	7	.3	[illegible]	7.7
Wilkes Barre	Pa	7	.4	[illegible]	6.9
Loquillo Mtns	P. R*	6	2.8	9.1	5.8
San Juan	P. R*	6	4.4	10.5	7.6
Providence	R. I	7	.5	8.9	4.3
Washington County	R. I*	5	1.3	7.8	4.4
Columbia	S. C	7	9.1	13.7	11.2
Greenville	S. C	6	4.7	15.5	9.3
Richland County	S. C*	6	3.2	11.7	7.0

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TABLE 1.—FISSION PRODUCT GROSS BETA ACTIVITY IN SURFACE AIR, NASN, FIRST QUARTER 1962

[Concentrations in $\mu\mu c/m^3$]

Station location		Number of samples	Minimum	Maximum	Average
City or county	State				
Black Hills Forest	S. D*	6	4.6	14.5	9.2
Sioux Falls	S. D.	6	3.7	11.0	7.1
Chattanooga	Tenn	7	2.8	9.4	5.5
Memphis	Tenn	7	3.7	12.8	8.9
Nashville	Tenn	6	1.2	20.6	10.1
Arkansas County	Texas*	5	6.9	13.1	10.0
Corpus Christi	Tex	7	2.4	17.6	9.2
Dallas	Tex	7	5.0	18.0	9.4
El Paso	Tex	6	8.7	21.0	14.0
Ft Worth	Tex	7	3.6	15.7	8.9
Houston	Tex	7	2.8	16.1	8.5
San Antonio	Tex	6	3.3	14.7	6.0
Waco	Tex	6	2.9	14.2	8.5
Salt Lake City	Utah	6	3.5	11.9	7.3
Burlington	Vt	6	3.9	11.3	7.3
Orange County	Vt*	6	4.4	6.8	5.6
Danville	Va	7	6.5	14.5	9.7
Norfolk	Va	7	5.5	14.9	9.9
Shenandoah Nat Pk	Va*	6	8.3	12.9	10.2
Clallam County	Wash*	4	2.1	8.2	5.3
Seattle	Wash	6	3.6	10.5	7.2
Tacoma	Wash	3	1.9	14.3	9.3
Charleston	W. Va	6	3.3	11.2	8.1
Huntington	W. Va	5	.7	10.7	5.7
Door County	Wis*	5	2.4	10.1	5.4
Milwaukee	Wis	6	3.4	7.9	4.7
Racine	Wis	5	1.6	6.9	3.7
Cheyenne	Wyo	6	4.3	21.5	11.4
Yellowstone Pk	Who	6	4.7	30.8	11.4
Network average					7.85

* Nonurban Station.

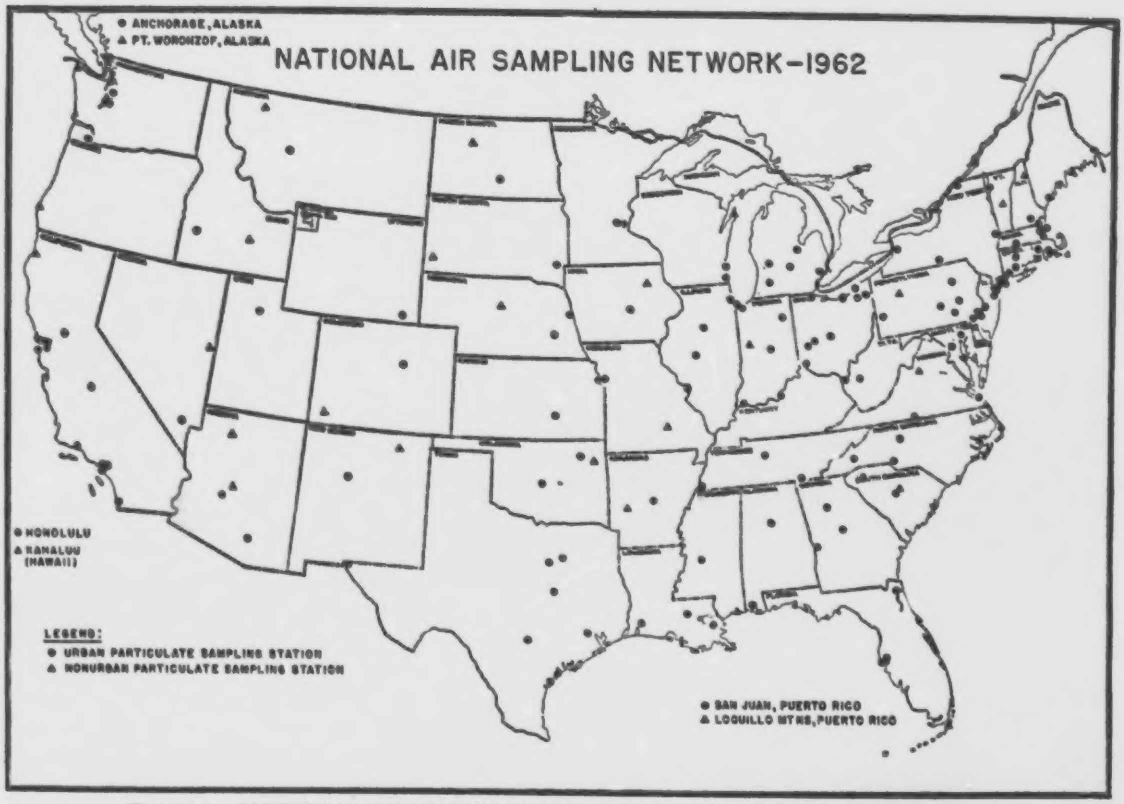
NATIONAL AIR SAMPLING NETWORK-1962
● ANCHORAGE, ALASKA
▲ PT. WORONZOF, ALASKA
● HONOLULU
▲ KANALUU (HAWAII)
LEGEND:
● URBAN PARTICULATE SAMPLING STATION
▲ NONURBAN PARTICULATE SAMPLING STATION
● SAN JUAN, PUERTO RICO
▲ LOQUILLO MTNS, PUERTO RICO

FIGURE 1.—NATIONAL AIR SAMPLING NETWORK SAMPLING STATIONS, 1962

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TABLE 2.—FISSION PRODUCT BETA ACTIVITY IN PRECIPITATION, FIRST QUARTER 1962

Station	January		February		March	
	μμc/liter	μμc/m²	μμc/liter	μμc/m²	μμc/liter	μμc/m²
Montgomery, Ala	444	51,500	204	10,300	1205	231,000
Santa Maria, Calif	314	14,500	120	23,200	—	—
Tampa, Fla	—	—	—	—	1255	100,000
Chicago (Midway), Ill.	557	51,800	533	28,000	3270	162,000
Lake Charles, La	156	17,800	—	—	—	—
Nantucket, Mass	304	32,500	420	51,000	—	—
Sault St. Marie, Mich	1054	40,500	80	4,900	—	—
St. Cloud, Minn	—	—	140	5,400	—	—
Columbia, Miss	—	—	380	14,700	860	46,000
Albany, N. Y	—	—	435	33,400	1216	68,000
Cape Hatteras, N. C	189	32,500	—	—	1300	146,000
Cincinnati, (Airport), Ohio	550	33,600	272	31,200	920	81,000
Cincinnati, (WBRS), Ohio	—	—	86	10,800	1270	109,000
Philadelphia, Pa	730	42,500	460	29,800	790	52,000
Charleston, S. C	418	23,800	—	—	750	144,000
Greenville, S. C	861	96,400	416	48,000	1340	258,000
Nashville, Tenn	383	59,000	95	18,800	910	125,000
Sterling, Va. (Washington, D. C.)	406	17,900	400	37,200	580	61,000
Tatoosh Island, Wash	631	92,400	300	22,500	730	100,000

PRECIPITATION COLLECTION STATIONS

Alabama: Montgomery
California: Santa Maria
Colorado: Grand Junction
Florida: Tampa
Idaho: Pocatello
Illinois:
  Chicago (Midway Airport)
  Chicago (O'Hare Airport)
Louisiana: Lake Charles
Maine: Caribou
Maryland: Silver Hill
Massachusetts: Nantucket
Michigan: Sault Ste. Marie
Minnesota: St. Cloud
Missouri: Columbia
Montana: Glasgow
Nebraska: Grand Island
Nevada: Las Vegas
New York: Albany
North Carolina: Cape Hatteras
Ohio:
  Cincinnati (research station)
  Cincinnati (airport)
Pennsylvania: Philadelphia
South Carolina:
  Charleston
  Greenville
Tennessee: Nashville
Texas:
  Brownsville
  San Angelo
  Amarillo
Virginia: Sterling
Washington: Tatoosh Island

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SECTION II.—FOOD

Radionuclides In Institutional Diet Samples

January 1961–February 1962

Division of Radiological Health, Public Health Service

The determination of radionuclide concentrations in the diet constitutes an important element of an integrated program of environmental radiation surveillance and assessment. In recognition of the potential significance of the diet in the total picture of environmental radiation, the Public Health Service in 1961 initiated its Institutional Diet Sampling Program. This program is being administered by the Division of Radiological Health with the assistance of the Service's Division of Environmental Engineering and Food Protection.

The program is designed to estimate the dietary intake of radionuclides in a controlled population group ranging from children to young adults of school age. Initially, the program consisted of sampling diets in eight institutions, but it has since been expanded to include 20 boarding schools or institutions, geographically distributed as shown in figure 1. Institutions selected include both exclusive, well-funded boarding schools to orphanages with severe economic limitations. Each institution (sampling point) is located in a community participating in the Pasteurized Milk Monitoring Program and the Drinking Water Analysis Program. The analytical data from these two activities are used to supplement the findings from the Institutional Diet Sampling Program.

Sampling Procedure

In general, the sampling procedure is the same in each case. Each sample represents the edible portion of the diet for a full 7-day week (21 meals plus soft drinks, candy bars, or other in-between snacks obtained by duplicating the meals of a different individual each day). Each institution supplies one total 7-day, 21-meal diet sample each month. Meals are frozen following collection. On completion of

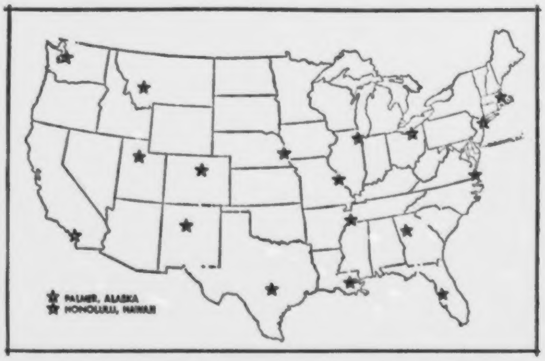

FIGURE 1.—INSTITUTIONAL DIET SAMPLING LOCATIONS, FEBRUARY 1962

the total sample, it is packed in dry ice and shipped by air express to either the Southwestern Radiological Health Laboratory at Las Vegas, Nevada, the Southeastern Radiological Health Laboratory at Montgomery, Alabama, or the Northeastern Radiological Health Laboratory at Winchester, Massachusetts. Samples usually range in volume from 6 to 16 liters and weigh from 8 to 20 kilograms.

A record of the components of each meal and the approximate meal weight is maintained by the institution's dietician. This record and a menu are sent in with each sample.

Analytical Program

Total weight, ash, and moisture determinations, as well as stable calcium and potassium, are obtained by conventional gravimetric or spectrophotometric methods. Phosphate determinations are made by colorimetric technique. Calcium and phosphorus determinations were included in the analytical program because calcium or phosphorus compounds may have an effect on the uptake of important bone-seeking radionuclides such as strontium–89 and 90.

The radionalysis program is designed around three basic procedures: (1) gamma spectroscopy, (2) chemical separation of strontium–89 and 90 with subsequent counting, and (3) total radium analysis. In the absence of interference, other than naturally-occurring radioactive potassium (K^{40}), minimum detectable concentrations for the gamma scan on a per-kilogram basis are: I^{131}, 10 μμc/kg; Cs^{137}, 5 μμc/kg; and Ba^{140}, 10 μμc/kg. Approximate minimum detectable concentrations for Sr^{89} and Sr^{90} are 5 and 1 μμc/kg respectively. The minimum detectable concentration for total radium during 1961 was about 5 μμc/kg and has been reduced to 1 μμc/kg beginning with the January 1962 data.

Total radium is determined by ashing, separation, and coprecipitation of radium and barium sulphate or chromate. After transfer to planchets, alpha activity is measured by an internal proportional counter with an appropriate delay for checking ingrowth of radium daughters. The total radium technique is a practical screening indicator. Other naturally occurring radionuclides may contribute to the reported total radium values. The bone dose calculated by assuming radium–226 at about 30 percent of the total radium is therefore a moderately high value. Future plans call for the acquisition of special equipment to perform specific determinations of radium–226.

Data Treatment

Tables 1 through 4 present the dietary intake data expressed on a per-day basis from the beginning of the program in January 1961 to February 1962. These four tables group the data as follows: (1) total weight, water, and ash; (2) calcium, phosphate, and potassium; (3) strontium–89, strontium–90, and total radium; and (4) iodine–131, cesium–137, and barium–140.

Certain of the radioanalyses are reported by the laboratories as being non-detectable (ND) or "less than" (<) a specified value. For this reason, special treatment of the data was required for the calculation of meaningful averages. The data prior to September 1961 was treated differently than that after September due to the arrival of fresh fission product activity sometime after September 15, 1961, from the U.S.S.R. nuclear test series, which began September 1.

During January-September 1961, strontium–89, iodine–131, and barium–140 data, when presented as being ND, were assumed to be equal to zero for averaging purposes. The half-lives of these three radionuclides are sufficiently short so that they would have decayed to insignificant amounts during the testing moratorium. On the other hand, cesium–137 has a sufficiently long half-life and was averaged with its full "less than" values.

During September 1961–February 1962, strontium–89, iodine–131, and barium–140 data, when presented as being "less than" were assumed to be equal to the full "less than" values when averaging. All other data (strontium–90, total radium, and cesium–137), whether before or after the resumption of testing, were assumed to be equal to the full "less than" value when averaging.

The placement of a "less than" sign (<) in front of an average was dependent upon the following rule: If the sum of the "less than" values is equal to or greater than 20 percent of the total sum, the true average is assumed

(Continued on page 242)

TABLE 1.—TOTAL WEIGHT, WATER AND

[Based on 7-day

Station location	January 1961			February 1961			March 1961		
	Total weight kg/day	Water kg/day	Ash gm/day	Total weight kg/day	Water kg/day	Ash gm/day	Total weight kg/day	Water kg/day	Ash gm/day
Alaska Palmer	[a]—	—	—	—	—	—	—	—	—
California Los Angeles	—	—	—	1.54	—	13.4	2.56	—	16.2
Colorado Denver	1.01	—	8.85	1.83	—	17.6	2.08	—	24.0
Florida Tampa	—	—	—	—	—	—	—	—	—
Georgia Atlanta	—	—	—	—	—	—	1.73	—	18.4
Hawaii Honolulu	—	—	—	—	—	—	—	—	—
Illinois Chicago	—	—	—	—	—	—	—	—	—
Ohio Cleveland	—	—	—	—	—	—	—	—	—
Louisiana New Orleans	—	—	—	—	—	—	—	—	—
Massachusetts Boston	—	—	—	—	—	—	—	—	—
Missouri St. Louis	1.77	—	14.9	2.30	—	22.7	1.88	—	21.0
Montana Helena	—	—	—	—	—	—	—	—	—
Nebraska Omaha	—	—	—	—	—	—	—	—	—
New Mexico Albuquerque	—	—	—	—	—	—	—	—	—
New York New York	1.51	—	15.0	1.21	—	10.3	1.08	—	11.3
Tennessee Memphis	—	—	—	—	—	—	—	—	—
Texas Austin	—	—	—	2.41	—	21.7	2.44	—	26.4
Utah Salt Lake City	—	—	—	—	—	—	—	—	—
Virginia Norfolk	—	—	—	—	—	—	—	—	—
Washington Seattle	—	—	—	2.21	—	21.0	2.63	—	19.7
Averages	1.43	—	12.9	1.92	—	17.8	2.06	—	19.6

[a] Dash indicates no samples collected.
[b] Data discarded because of sample leakage in shipment or sampling errors.

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ASH OF INSTITUTIONAL DIET SAMPLES

composite samples]

April 1961			May 1961			June 1961			July 1961		
Total weight kg/day	Water kg/day	Ash gm/day	Total weight kg/day	Water kg/day	Ash gm/day	Total weight kg/day	Water kg/day	Ash gm/day	Total weight kg/day	Water kg/day	Ash gm/day
—	—	—	—	—	—	—	—	—	—	—	—
1.71	1.31	14.3	1.71	1.31	14.3	1.70	1.27	7.4	0.77	0.57	7.0
1.69	—	17.6	2.97	2.23	28.3	1.39	1.04	8.71	2.67	2.13	23.7
—	—	—	—	—	—	—	—	—	—	—	—
1.85	—	19.1	1.59	—	17.0	1.35	0.97	17.6	1.68	1.33	13.7
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	1.59	—	15.7	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
2.28	—	25.1	1.70	1.33	12.9	3.21	2.51	29.1	2.64	2.01	30.4
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
(b)	(b)	(b)	1.45	1.03	15.4	1.63	1.23	14.3	(b)	(b)	(b)
—	—	—	—	—	—	—	—	—	—	—	—
2.47	—	23.6	2.10	1.54	21.8	2.47	1.77	26.6	2.40	1.78	23.4
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
2.41	—	24.1	2.16	1.66	21.8	2.43	1.90	21.1	1.97	1.54	19.3
2.07	1.31	20.6	1.91	1.52	18.4	2.02	1.53	17.8	2.02	1.56	19.6

TABLE 1.—TOTAL WEIGHT, WATER, AND

[Based on 7-day

Station location	August 1961			September 1961			October 1961		
	Total weight kg/day	Water kg/day	Ash gm/day	Total weight kg/day	Water kg/day	Ash gm/day	Total weight kg/day	Water kg/day	Ash gm/day
Alaska Palmer	[a] —	—	—	—	—	—	1.63	1.27	14.7
California Los Angeles	1.34	1.13	9.4	1.96	1.71	20.3	1.36	1.14	14.9
Colorado Denver	2.67	2.08	29.1	2.48	2.08	24.8	1.94	1.47	19.4
Florida Tampa	—	—	—	—	—	—	2.24	1.61	27.4
Georgia Atlanta	1.67	1.37	9.3	1.14	0.79	12.4	1.52	1.04	13.7
Hawaii Honolulu	—	—	—	—	—	—	—	—	—
Illinois Chicago	—	—	—	[b]	[b]	[b]	1.78	1.36	19.7
Ohio Cleveland	—	—	—	—	—	—	—	—	—
Louisiana New Orleans	—	—	—	—	—	—	—	—	—
Massachusetts Boston	—	—	—	—	—	—	1.96	1.27	19.7
Missouri St. Louis	—	—	—	[b]	[b]	[b]	2.71	1.93	27.1
Montana Helena	—	—	—	—	—	—	—	—	—
Nebraska Omaha	—	—	—	—	—	—	—	—	—
New Mexico Albuquerque	—	—	—	—	—	—	—	—	—
New York New York	1.30	0.91	15.1	1.25	0.90	11.3	1.32	0.91	13.1
Tennessee Memphis	—	—	—	—	—	—	1.82	1.20	17.7
Texas Austin	2.60	1.90	25.1	2.73	1.97	26.4	2.73	1.97	25.7
Utah Salt Lake City	—	—	—	—	—	—	—	—	—
Virginia Norfolk	—	—	—	—	—	—	—	—	—
Washington Seattle	2.30	1.88	21.4	2.26	1.56	27.1	2.56	2.23	33.3
Averages	1.98	1.54	18.2	1.97	1.50	20.4	1.96	1.45	20.5

[a] Dash indicates no samples collected.
[b] Data discarded because of sample leakage in shipment or sampling errors.

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ASH OF INSTITUTIONAL DIET SAMPLES—Continued

composite samples]

November 1961			December 1961			January 1962			February 1962		
Total weight kg/day	Water kg/day	Ash gm/day	Total weight kg/day	Water kg/day	Ash gm/day	Total weight kg/day	Water kg/day	Ash gm/day	Total weight kg/day	Water kg/day	Ash gm/day
2.24	1.37	15.7	1.87	1.37	20.7	1.16	0.50	10.4	2.01	1.74	20.1
1.56	1.16	29.6	1.36	1.10	10.9	1.86	1.16	13.0	1.27	0.97	7.63
1.70	1.26	17.0	2.24	1.79	22.4	—	—	—	1.78	1.41	16.1
1.43	9.85	12.7	—	—	—	—	—	—	—	—	—
1.34	0.96	14.3	1.73	1.21	16.9	1.79	0.51	17.3	1.39	9.02	14.8
2.01	1.53	16.1	2.21	1.70	20.0	2.20	1.63	17.6	2.24	1.69	11.2
1.53	1.19	16.9	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	1.85	1.41	17.3	1.65	1.25	16.4
—	—	—	—	—	—	1.89	1.46	17.1	2.16	14.1	20.3
2.36	1.13	24.4	—	—	—	1.67	1.23	15.3	2.10	1.61	20.8
2.73	1.97	30.0	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	1.98	1.53	21.8	—	—	—
—	—	—	—	—	—	2.31	1.86	13.9	1.70	1.29	8.50
—	—	—	—	—	—	1.40	1.06	15.4	1.24	0.89	9.92
1.45	1.11	13.1	1.26	0.89	11.6	1.13	0.81	10.7	—	—	—
2.16	1.51	23.0	1.87	1.33	19.1	2.20	1.64	20.7	2.18	1.53	19.7
2.70	1.34	25.8	2.12	1.40	20.0	2.44	1.60	27.1	1.25	0.92	11.5
2.48	2.04	19.8	1.77	1.10	14.1	1.67	1.30	13.4	1.76	1.31	12.3
—	—	—	—	—	—	1.98	1.34	21.4	1.79	0.49	20.8
2.38	1.86	26.3	2.30	1.63	23.0	3.17	2.47	28.5	3.17	2.47	28.6
2.00	2.02	20.3	1.87	1.37	17.9	1.92	1.36	17.6	1.85	2.71	15.9

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TABLE 2.—CALCIUM, PHOSPHATE AND

[Based on 7-day

Station location	January 1961			February 1961			March 1961		
	Ca gm/day	PO₄ gm/day	K gm/day	Ca gm/day	PO₄ gm/day	K gm/day	Ca gm/day	PO₄ gm/day	K gm/day
Alaska Palmer [b]	[a]—	—	—	—	—	—	—	—	—
California Los Angeles	—	—	—	0.65	—	1.54	0.80	—	1.55
Colorado Denver	0.55	—	0.51	0.88	—	1.64	1.50	—	3.75
Florida Tampa	—	—	—	—	—	—	—	—	—
Georgia Atlanta	—	—	—	—	—	—	1.00	3.84	2.43
Hawaii Honolulu	—	—	—	—	—	—	—	—	—
Illinois Chicago	—	—	—	—	—	—	—	—	—
Ohio Cleveland	—	—	—	—	—	—	—	—	—
Louisiana New Orleans	—	—	—	—	—	—	—	—	—
Massachusetts Boston	—	—	—	—	—	—	—	—	—
Missouri St. Louis	0.73	—	1.95	0.99	—	2.98	1.21	—	1.31
Montana Helena	—	—	—	—	—	—	—	—	—
Nebraska Omaha	—	—	—	—	—	—	—	—	—
New Mexico Albuquerque	—	—	—	—	—	—	—	—	—
New York New York	0.34	2.18	2.50	0.60	2.34	1.88	0.47	2.27	1.34
Tennessee Memphis	—	—	—	—	—	—	—	—	—
Texas Austin	—	—	—	1.26	5.28	3.77	1.44	6.18	3.43
Utah Salt Lake City	—	—	—	—	—	—	—	—	—
Virginia Norfolk	—	—	—	—	—	—	—	—	—
Washington Seattle	—	—	—	0.97	—	2.21	1.23	—	2.37
Averages	0.54	2.18	1.65	0.89	3.81	2.34	1.09	4.10	2.31

[a] Dash indicates no sample collected.
[b] Data discarded because of sampling errors or sample leakage in shipment.

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POTASSIUM CONTENT OF INSTITUTIONAL DIET SAMPLES

composite samples]

April 1961			May 1961			June 1961			July 1961		
Ca gm/day	PO_4 gm/day	K gm/day	Ca gm/day	PO_4 gm/day	K gm/day	Ca gm/day	PO_4 gm/day	K gm/day	Ca gm/day	PO_4 gm/day	K gm/day
—	—	—	—	—	—	—	—	—	—	—	—
0.99	3.84	2.40	0.99	3.84	2.40	2.36	9.74	2.21	0.62	1.80	1.16
1.08	3.84	1.68	1.84	8.32	3.86	1.47	4.79	2.08	1.79	6.37	4.01
—	—	—	—	—	—	—	—	—	—	—	—
1.19	4.86	2.76	0.90	4.44	2.50	1.31	3.06	1.96	0.83	3.14	1.71
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	0.90	4.14	2.51	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
1.39	5.69	2.74	0.82	3.57	2.04	1.61	8.77	4.50	1.74	7.66	3.43
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
b	b	b	0.73	2.94	2.43	0.99	3.28	2.00	b	b	b
—	—	—	—	—	—	—	—	—	—	—	—
1.51	6.14	3.26	1.29	5.41	2.21	1.60	6.56	2.93	1.40	5.85	2.71
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
1.13	6.66	4.34	1.14	5.61	2.80	2.01	7.53	3.16	1.28	5.12	2.96
1.21	5.14	2.86	1.08	4.78	2.59	1.62	6.33	2.69	1.28	4.95	2.66

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TABLE 2.—CALCIUM, PHOSPHATE, AND

[Based on 7-day

Station location	August 1961			September 1961			October 1961		
	Ca gm/day	PO_4 gm/day	K gm/day	Ca gm/day	PO_4 gm/day	K gm/day	Ca gm/day	PO_4 gm/day	K gm/day
Alaska Palmer	[a]—	—	—	—	—	—	0.54	2.85	2.18
California Los Angeles	0.47	2.16	2.01	1.47	5.69	2.54	0.57	3.23	2.03
Colorado Denver	2.72	7.64	2.94	1.84	6.66	3.68	0.95	4.39	2.99
Florida Tampa	—	—	—	—	—	—	1.57	6.43	2.86
Georgia Atlanta	.056	2.00	1.71	0.54	2.11	1.57	0.69	2.86	2.28
Hawaii Honolulu	—	—	—	—	—	—	—	—	—
Illinois Chicago	—	—	—	[b]	[b]	[b]	1.19	5.14	2.71
Ohio Cleveland	—	—	—	—	—	—	—	—	—
Louisiana New Orleans	—	—	—	—	—	—	—	—	—
Massachusetts Boston	—	—	—	—	—	—	1.37	5.00	2.43
Missouri St. Louis	—	—	—	[b]	[b]	[b]	1.28	6.38	4.74
Montana Helena	—	—	—	—	—	—	—	—	—
Nebraska Omaha	—	—	—	—	—	—	—	—	—
New Mexico Albuquerque	—	—	—	—	—	—	—	—	—
New York New York	1.20	4.71	2.14	0.46	2.06	2.00	0.93	2.71	1.86
Tennessee Memphis	—	—	—	—	—	—	1.06	3.86	2.43
Texas Austin	1.57	7.00	3.43	1.57	5.85	3.43	1.71	6.71	3.28
Utah Salt Lake City	—	—	—	—	—		—	—	—
Virginia Norfolk	—	—	—	—	—	—	—	—	—
Washington Seattle	1.31	6.07	3.21	1.92	7.36	3.16	3.27	7.23	4.08
Averages	1.30	4.93	2.57	1.30	4.95	2.73	1.26	4.73	2.82

[a] Dash indicates no samples collected.
[b] Data discarded because of sampling errors or sample leakage in shipment.

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POTASSIUM CONTENT OF INSTITUTIONAL DIET SAMPLES—Continued

composite samples]

November 1961			December 1961			January 1962			February 1962		
Ca gm/day	PO₄ gm/day	K gm/day	Ca gm/day	PO₄ gm/day	K gm/day	Ca gm/day	PO₄ gm/day	K gm/day	Ca gm/day	PO₄ gm/day	K gm/day
0.65	3.30	3.45	0.97	5.08	2.96	0.66	2.51	1.60	1.12	4.28	2.86
1.29	6.80	2.64	0.34	2.88	2.03	0.49	3.07	2.51	0.45	1.80	2.13
0.83	4.01	2.90	1.54	5.47	3.58	—	—	—	0.15	3.87	2.68
0.76	3.28	1.86	—	—	—	—	—	—	—	—	—
0.84	4.14	1.71	0.96	4.18	2.43	1.00	4.57	2.28	0.76	3.57	1.86
0.52	3.34	2.91	0.73	4.06	3.14	0.93	4.14	2.40	0.96	2.31	2.70
0.93	3.71	2.28	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	1.36	5.14	2.28	1.27	4.43	2.86
—	—	—	—	—	—	1.23	4.57	2.28	1.16	4.43	2.66
1.94	6.00	3.86	—	—	—	1.24	4.57	2.57	1.57	5.00	2.86
1.39	6.35	4.58	—	—	—	—	[illegible]	—	—	—	—
—	—	—	—	—	—	1.27	[illegible]	2.53	—	—	—
[illegible]	[illegible]	[illegible]	[illegible]	—	—	1.01	3.80	3.21	0.75	1.94	2.34
[illegible]	[illegible]	[illegible]	[illegible]	—	—	0.87	3.51	[illegible]	0.89	2.46	1.91
[illegible]	[illegible]	2.28	[illegible]	2.86	1.57	0.51	2.57	1.43	—	—	—
[illegible]	[illegible]	3.28	1.14	4.14	2.71	1.26	5.43	2.86	0.99	4.28	2.80
1.81	6.71	3.57	1.40	5.24	2.86	1.47	7.00	3.00	0.73	2.57	1.57
0.87	4.95	3.36	0.64	3.78	2.88	0.80	3.64	2.46	0.80	2.77	2.61
—	—	—	—	—	—	0.80	4.43	2.86	0.90	3.86	2.14
1.46	6.82	3.81	1.11	5.38	3.20	1.84	6.65	9.58	1.64	6.81	4.00
1.10	4.84	3.04	0.94	4.36	2.74	1.04	4.45	2.77	0.94	3.62	2.59

TABLE 3.—Sr^{89}, Sr^{90} and Ra

[Based on 7-day

Station location	January 1961			February 1961			March 1961		
	Sr^{89} µµc/day	Sr^{90} µµc/day	Total Ra µµc/day	Sr^{89} µµc/day	Sr^{90} µµc/day	Total Ra µµc/day	Sr^{89} µµc/day	Sr^{90} µµc/day	Total Ra µµc/day
Alaska Palmer	[a]—	—	—	—	—	—	—	—	—
California Los Angeles	—	—	—	—	5.4	2.6	—	3.4	6.0
Colorado Denver	—	3.4	2.3	—	10.6	1.7	—	2.6	12.6
Florida Tampa	—	—	—	—	—	—	—	—	—
Georgia Atlanta	—	—	—	—	—	—	[b]ND	9.4	3.0
Hawaii Honolulu	—	—	—	—	—	—	—	—	—
Illinois Chicago	—	—	—	—	—	—	—	—	—
Ohio Cleveland	—	—	—	—	—	—	—	—	—
Louisiana New Orleans	—	—	—	—	—	—	—	—	—
Massachusetts Boston	—	—	—	—	—	—	—	—	—
Missouri St. Louis	—	13.3	6.0	—	13.1	7.3	—	4.1	7.7
Montana Helena	—	—	—	—	—	—	—	—	—
Nebraska Omaha	—	—	—	—	—	—	—	—	—
New Mexico Albuquerque	—	—	—	—	—	—	—	—	—
New York New York	ND	6.9	<2.9	ND	2.7	<2.9	ND	5.0	<2.9
Tennessee Memphis	—	—	—	—	—	—	—	—	—
Texas Austin	—	—	—	ND	8.7	<4.6	ND	10.4	<3.6
Utah Salt Lake City	—	—	—	—	—	—	—	—	—
Virginia Norfolk	—	—	—	—	—	—	—	—	—
Washington Seattle	—	—	—	—	12.6	3.7	—	5.7	2.1
Averages	ND	7.9	<3.7	ND	8.8	<3.8	ND	5.8	<5.4

[a] Dash indicates no sample collected.
[b] ND indicates concentration is below the minimum level of detection. For averaging, "ND" is assumed to be equal to zero.
[c] Data discarded because of sample leakage in shipment, or sampling errors.

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CONTENT OF INSTITUTIONAL DIET SAMPLES

composite samples]

April 1961			May 1961			June 1961			July 1961		
Sr^{89} μμc/day	Sr^{90} μμc/day	Total Ra μμc/day	Sr^{89} μμc/day	Sr^{90} μμc/day	Total Ra μμc/day	Sr^{89} μμc/day	Sr^{90} μμc/day	Total Ra μμc/day	Sr^{89} μμc/day	Sr^{90} μμc/day	Total Ra μμc/day
—	—	—	—	—	—	—	—	—	—	—	—
—	4.0	5.1	—	4.0	5.1	—	<1.7	3.9	—	4.1	5.4
—	3.0	6.7	—	7.4	6.9	—	2.3	7.7	—	4.8	12.0
—	—	—	—	—	—	—	—	—	—	—	—
ND	8.7	<2.9	ND	7.0	4.0	ND	9.1	<7.9	ND	7.1	7.1
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	ND	6.4	7.4	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	7.6	10.0	—	6.0	4.7	—	<3.1	10.3	—	9.0	12.7
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
*	*	*	ND	5.0	2.9	ND	5.6	<3.6	*	*	*
—	—	—	—	—	—	—	—	—	—	—	—
ND	10.4	<3.6	ND	9.3	<7.1	ND	5.0	<10.0	ND	14.0	<10.0
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	9.9	6.6	—	3.3	3.3	—	8.3	11.8	—	2.0	8.4
ND	7.3	5.7	ND	6.0	5.2	ND	5.0	<9.2	ND	6.8	9.3

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TABLE 3.—Sr^{89}, Sr^{90} and Ra

(Based on 7-day

Station location	August 1961			September 1961			October 1961		
	Sr^{89} μμc/day	Sr^{90} μμc/day	Total Ra μμc/day	Sr^{89} μμc/day	Sr^{90} μμc/day	Total Ra μμc/day	Sr^{89} μμc/day	Sr^{90} μμc/day	Total Ra μμc/day
Alaska **Palmer**	[a]—	—	—	—	—	—	—	8.9	1.6
California **Los Angeles**	—	2.1	2.1	—	8.6	5.3	—	1.4	11.0
Colorado **Denver**	—	10.4	8.0	—	6.7	9.1	—	12.9	1.7
Florida **Tampa**	—	—	—	—	—	—	<11.1	15.1	<10.0
Georgia **Atlanta**	[b]ND	4.7	<3.7	ND	5.1	<3.7	<7.6	7.1	<5.7
Hawaii **Honolulu**	—	—	—	—	—	—	—	—	—
Illinois **Chicago**	—	—	—	[c]	[c]	[c]	<8.9	10.3	<7.9
Ohio **Cleveland**	—	—	—	—	—	—	—	—	—
Louisiana **New Orleans**	—	—	—	—	—	—	—	—	—
Massachusetts **Boston**	—	—	—	—	—	—	<9.8	14.3	<7.9
Missouri **St. Louis**	—	—	—	[c]	[c]	[c]	—	6.9	<2.7
Montana **Helena**	—	—	—	—	—	—	—	—	—
Nebraska **Omaha**	—	—	—	—	—	—	—	—	—
New Mexico **Albuquerque**	—	—	—	—	—	—	—	—	—
New York **New York**	ND	9.3	<6.0	ND	5.8	<3.4	<6.6	3.9	<5.7
Tennessee **Memphis**	—	—	—	—	—	—	<9.0	13.1	<7.1
Texas **Austin**	ND	12.4	<10.0	ND	17.4	<7.9	<13.6	11.9	<10.0
Utah **Salt Lake City**	—	—	—	—	—	—	—	—	—
Virginia **Norfolk**	—	—	—	—	—	—	—	—	—
Washington **Seattle**	—	8.1	6.0	—	7.7	9.3	—	6.9	7.7
Averages	ND	8.1	<6.0	ND	8.5	<6.4	<9.5	9.4	<6.6

[a] Dash indicates no sample collected.
[b] ND indicates concentration is below the minimum level of detection. For averaging "ND" is assumed to be equal to zero.
[c] Data discarded because of sampling errors or sample leakage in shipment.

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CONTENT OF INSTITUTIONAL DIET SAMPLES—Continued

composite samples)

November 1961			December 1961			January 1962			February 1962		
Sr^{89} μμc/day	Sr^{90} μμc/day	Total Ra μμc/day	Sr^{89} μμc/day	Sr^{90} μμc/day	Total Ra μμc/day	Sr^{89} μμc/day	Sr^{90} μμc/day	Total Ra μμc/day	Sr^{89} μμc/day	Sr^{90} μμc/day	Total Ra μμc/day
—	4.7	6.3	—	1.3	6.7	—	3.0	2.3	—	6.8	<2.0
—	21.6	9.1	—	1.6	3.9	—	2.3	2.3	—	3.0	<0.9
—	10.6	10.6	—	8.6	5.9	—	—	—	—	7.7	<1.9
22.9	5.6	<5.7	—	—	—	—	—	—	—	—	—
15.0	5.7	<8.7	42.9	5.0	6.9	<9.3	7.4	<1.9	42.1	6.6	2.9
—	7.7	4.6	—	2.0	24.3	—	5.3	3.7	—	13.0	<1.9
24.3	5.6	<7.1	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	<9.3	10.0	9.7	<8.6	9.1	<1.7
—	—	—	—	—	—	248.5	17.8	<1.9	122.8	19.6	2.4
80.0	18.3	<10.0	—	—	—	<8.6	10.0	6.9	<10.7	13.7	2.7
—	13.4	3.6	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	4.0	2.6	—	—	—
—	—	—	—	—	—	—	4.4	2.6	—	7.1	<1.7
—	—	—	—	—	—	—	4.1	1.7	—	5.4	<1.2
<7.1	9.1	<5.7	<6.4	6.0	<1.3	5.7	4.7	<1.1	—	—	—
142.8	15.1	<10.0	164.2	10.1	9.6	103.5	14.3	<2.1	80.0	9.9	<2.3
92.1	9.0	<11.4	92.8	5.0	17.1	44.3	12.1	<2.4	21.4	5.7	<1.3
—	11.4	13.1	—	2.3	7.1	—	4.9	1.9	—	5.1	<1.8
—	—	—	—	—	—	38.6	12.1	5.7	78.5	12.7	<1.9
—	14.3	12.4	—	0.7	13.6	—	9.6	4.1	—	12.7	4.4
54.8	10.9	<8.2	76.6	4.3	9.6	58.5	7.9	3.3	52.0	9.2	<2.1

TABLE 4.—I^{131}, Cs^{137} AND Ba^{140}

[Based on 7-day

Station location	January 1961			February 1961			March 1961		
	I^{131} µµc/day	Cs^{137} µµc/day	Ba^{140} µµc/day	I^{131} µµc/day	Cs^{137} µµc/day	Ba^{140} µµc/day	I^{131} µµc/day	Cs^{137} µµc/day	Ba^{140} µµc/day
Alaska Palmer	[a]—	—	—	—	—	—	—	—	—
California Los Angeles	—	—	—	ND	<7.7	ND	ND	<12.9	ND
Colorado Denver	[b] ND	<5.1	ND	ND	<9.1	ND	ND	16.7	ND
Florida Tampa	—	—	—	—	—	—	—	—	—
Georgia Atlanta	—	—	—	—	—	—	ND	<10.0	—
Hawaii Honolulu	—	—	—	—	—	—	—	—	—
Illinois Chicago	—	—	—	—	—	—	—	—	—
Ohio Cleveland	—	—	—	—	—	—	—	—	—
Louisiana New Orleans	—	—	—	—	—	—	—	—	—
Massachusetts Boston	—	—	—	—	—	—	—	—	—
Missouri St. Louis	ND	<8.9	ND	ND	13.7	ND	ND	<9.4	ND
Montana Helena	—	—	—	—	—	—	—	—	—
Nebraska Omaha	—	—	—	—	—	—	—	—	—
New Mexico Albuquerque	—	—	—	—	—	—	—	—	—
New York New York	ND	70.0	ND	ND	<2.1	ND	ND	<5.7	ND
Tennessee Memphis	—	—	—	—	—	—	—	—	—
Texas Austin	—	—	—	ND	<12.1	ND	ND	<12.1	ND
Utah Salt Lake City	—	—	—	—	—	—	—	—	—
Virginia Norfolk	—	—	—	—	—	—	—	—	—
Washington Seattle	—	—	—	ND	8.9	ND	ND	31.4	ND
Averages	ND	28.0	ND	ND	<8.9	ND	ND	<14.0	ND

[a] Dash indicates no sample collected.
[b] ND indicates concentration is below the minimum level of detection. For averaging "ND" is assumed to be equal to zero.
[c] Data discarded because of sampling errors or sample leakage in shipment.

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CONTENT OF INSTITUTIONAL DIET SAMPLES

composite samples]

April 1961			May 1961			June 1961			July 1961		
I^{131} μμc/day	Cs^{137} μμc/day	Ba^{140} μμc/day	I^{131} μμc/day	Cs^{137} μμc/day	Ba^{140} μμc/day	I^{131} μμc/day	Cs^{137} μμc/day	Ba^{140} μμc/day	I^{131} μμc/day	Cs^{137} μμc/day	Ba^{140} μμc/day
—	—	—	—	—	—	—	—	—	—	—	—
ND	6.6	ND	ND	6.6	ND	ND	<8.5	ND	ND	15.4	ND
ND	16.9	ND	ND	104.0	ND	ND	15.3	ND	ND	26.7	ND
—	—	—	—	—	—	—	—	—	—	—	—
ND	25.0	ND	ND	<9.3	ND	ND	25.7	ND	ND	12.9	ND
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	ND	25.7	ND	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
ND	9.1	ND	ND	37.4	ND	ND	35.4	ND	ND	26.4	ND
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
*	*	*	ND	20.0	ND	ND	12.9	ND	*	*	*
—	—	—	—	—	—	—	—	—	—	—	—
ND	<21.4	ND	ND	<10.7	ND	ND	22.1	ND	ND	<12.1	ND
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
ND	<12.0	ND	ND	47.4	ND	ND	43.7	ND	ND	39.4	ND
ND	<15.2	ND	ND	39.6	ND	ND	23.4	ND	ND	22.1	ND

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TABLE 4.—I^{131}, Cs^{137} AND Ba^{140}

[Based on 7-day

Station location	August 1961			September 1961			October 1961		
	I^{13} μμc/day	Cs^{137} μμc/day	Ba^{140} μμc/day	I^{131} μμc/day	Cs^{1t} μμc/day	Ba^{140} μμc/day	I^{131} μ c/day	Cs^{137} μμc/day	Ba^{140} μμc/day
Alaska Palmer	[a]—	—	—	—	—	—	<16.3	41.1	<16.3
California Los Angeles	[b] ND	20.1	ND	<19.6	19.6	<19.6	<13.6	<6.7	<13.6
Colorado Denver	ND	53.4	ND	<24.8	<12.4	<24.8	<19.4	9.7	<19.4
Florida Tampa	—	—	—	—	—	—	<22.8	90.0	<22.8
Georgia Atlanta	ND	<8.6	ND	<11.4	<5.7	<11.4	228.5	15.0	<15.7
Hawaii Honolulu	—	—	—	—	—	—	—	—	—
Illinois Chicago	—	—	—	[c]	[c]	[c]	88.5	<8.6	<17.1
Ohio Cleveland	—	—	—	—	—	—	—	—	—
Louisiana New Orleans	—	—	—	—	—	—	—	—	—
Massachusetts Boston	—	—	—	—	—	—	98.5	28.6	<20.0
Missouri St. Louis	—	—	—	[c]	[c]	[c]	27.1	27 1	<27.1
Montana Helena	—	—	—	—	—	—	—	—	—
Nebraska Omaha	—	—	—	—	—	—	—	—	—
New Mexico Albuquerque	—	—	—	—	—	—	—	—	—
New York New York	ND	12.9	ND	<12.5	17.1	<12.5	<12.9	<6.4	<12.9
Tennessee Memphis	—	—		—	—		98.5	25.0	<18.6
Texas Austin	ND	<12.9	ND	<27.3	<13.6	<27.3	27.1	<13.6	<27.1
Utah Salt Lake City	—	—	—	—	—	—	—	—	—
Virginia Norfolk	—	—	—	—	—	—	—	—	—
Washington Seattle	ND	34.6	ND	<22.6	45.1	<22.6	25.6	38.3	<25.6
Average	ND	23.8	ND	<19.7	<18.8	<19.7	56.6	25.8	<19.7

[a] Dash indicates no sample collected.
[b] ND indicates concentration is below the minimum level of detection. For averaging "ND" is assumed to be equal to zero.
[c] Data discarded because of sampling errors or sample leakage in shipment.

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CONTENT OF INSTITUTIONAL DIET SAMPLES—Continued

composite samples]

November 1961			December 1961			January 1962			February 1962		
I^{131} μμc/day	Cs^{137} μμc/day	Ba^{140} μμc/day	I^{131} μμc/day	Cs^{137} μμc/day	Ba^{140} μμc/day	I^{131} μμc/day	Cs^{137} μμc/day	Ba^{140} μμc/day	I^{131} μμc/day	Cs^{137} μμc/day	Ba^{140} μμc/day
<22.3	67.3	44.9	<18.7	28.6	18.6	17.1	11.4	11.4	<20.1	30.1	<20.1
15.6	7.9	<15.6	<13.6	<6.8	<13.6	<18.5	27.8	47.1	<12.7	6.3	<12.7
<17.0	8.6	<17.0	67.1	22.9	22.9	—	—	—	<17.8	17.8	<17.8
21.4	178.5	<14.3	—	—	—	—	—	—	—	—	—
<13.6	<7.1	<12.9	<17.1	<8.6	<17.1	<18.6	9.3	<18.6	<14.3	22.1	<14.3
40.3	30.3	20.1	44.3	32.8	22.8	<22.0	32.8	44.3	<22.4	11.1	<22.4
25.7	<8.6	<15.7	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	<18.6	<9.3	<18.6	<17.1	<8.6	<17.1
—	—	—	—	—	—	<18.6	12.9	<18.6	<21.4	30.7	<21.4
71.4	<12.1	<22.8	—	—	—	<17.1	41.4	<17.1	<21.4	<10.7	<21.4
<27.3	27.3	<27.3	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	<19.8	20.0	40.0	—	—	—
—	—	—	—	—	—	<23.1	<11.6	34.3	<17.0	17.1	17.1
—	—	—	—	—	—	<14.0	<7.0	<14.0	<12.4	<6.2	<12.4
<14.3	<7.9	<14.3	<12.9	<6.4	<12.9	<11.4	<5.7	<11.4	—	—	—
42.8	<10.7	<22.1	<18.6	<10.0	<18.6	<21.4	<10.7	<21.4	<21.4	<10.7	<21.4
81.4	<13.6	<27.2	<21.4	<10.7	<21.4	<24.3	32.1	<24.3	<12.9	<6.4	<12.9
<49.7	12.4	<24.8	<17.7	17.7	<17.7	<16.7	<8.4	<16.7	<17.6	17.1	17.6
—	—	—	—	—	—	<20.0	<10.0	<20.0	<18.6	<9.3	<18.6
167.1	35.7	47.7	22.8	34.3	22.8	<31.7	31.4	31.4	<31.7	31.4	<31.7
50.8	30.6	<23.3	<25.4	<17.9	18.8	<19.6	<17.6	<24.3	<19.4	<15.7	<18.6

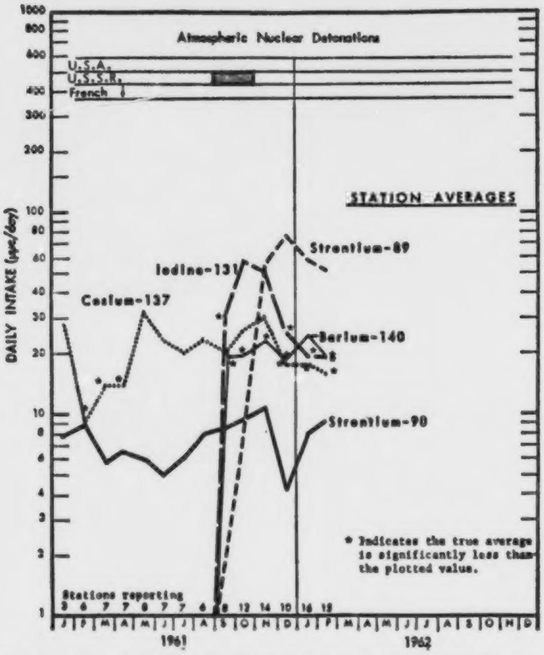

FIGURE 2.—RADIONUCLIDES IN INSTITUTIONAL DIET SAMPLES—STATION AVERAGES

to be significantly less than the calculated average. In such cases a "less than" sign precedes the average to denote this.

Radiation Protection Guide Comparisons

During the 14-month period reported, the dietary intake of strontium–90 ranged between 0.7 and 17.4 μμc/day with an average value of 7.5 μμc/day. The average lies within the lowest Radiation Protection Guide (RPG) limit of the Federal Radiation Council of 0 to 20 μμc/day for strontium–90 and the maximum at the bottom of Range II (20–200) (*1, 2*).

The dietary intake of total radium ranged between <1.1 and 29.7 μμc/day with an average of <6.1 μμc/day. Assuming the radium–226 component of the total radium activity is at least 30 percent, the intake of radium–226 via the diet probably exceeds the Range I level of the RPG (0 to 2 μμc/day for radium–226).

Following the resumption of nuclear weapons testing in the atmosphere in 1961, iodine–131 dietary intake increased from non-detectable to a station high of 228.5 μμc/day with an average during the reported 14 months of <14.5 μμc/day. This average was in Range II of the iodine–131 RPG (10–100 μμc/day) while the one month high at one station was in Range III (100–1000 μμc/day). The May 1962 *RHD* contains a discussion of environmental radiation protection standards which should be referred to for an understanding of the RPG (*2*).

The variation in strontium–90 and total radium contents could not be attributed to the presence of any specific diet item, even though attempts were made to document the diet items by menu as served at the sampling point. Comparison of the total diet intake levels of strontium–90 with those previously reported for milk confirms previous estimates that the milk may account for approximately one-half of the dietary intake of the radionuclide.

REFERENCES

(*1*) Federal Radiation Council, "Background Material for the Development of Radiation Protection Standards, Report No. 2," Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. (September 1961).

(*2*) Chadwick, Donald R. and Conrad P. Straub, "Considerations in Establishing Radiation Protection Standards for Radioactivity in the Environment," *Radiological Health Data*, III: 159 (May 1962).

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Strontium-90 Content of the Diet of Children and Juveniles in the Federal Republic of Germany During 1959[1]

D. Merten and E. Knoop, Physikalisches Institut der Bundesforschungsanstalt für Milchwirtschaft, Kiel, Germany

The following tables present the results of assays conducted in the Federal Republic of Germany for strontium-90 in the diet of children and juveniles during 1959.

Data appearing in tables 1 and 2 were abstracted from the report, "The Strontium-90 Content of the Diet of Children and Juveniles in 1959," by D. Merten and E. Knoop, Physikalisches Institut der Bundesforschungsanstalt für Milchwirtschaft, Kiel, Germany, for the United Nations Scientific Committee on the Effects of Atomic Radiation. This abstract was prepared by Dr. Merten.

Estimates were made of the average daily intake of strontium-90 by children through the chief categories of food, i.e., bread, potatoes, vegetables, fruits, and milk. The figures given were divided into age groups from 0 to 20 years. Data on the specific activity of the individual products were obtained from various investigations and were completed by taking data from the literature. The figures for food consumption used for estimating the daily intake of strontium-90 by children and juveniles through their diet were taken partly from publications and partly from the results of an inquiry into the dietary habits of 2,000 children.

Generally speaking, it has been found that the amount of strontium-90 offered in food increased at a rate corresponding to the increase in consumption due to age. On the average, the total amount of strontium-90 increased from 8 μμc/day in the age group of 1-3 years to 13 μμc/day in the group 15-20 years, i.e., by some 60 percent. Departures from these figures may be explained by differences in the qualitative and quantitative compositions of the diet due to different environments. The amount of strontium-90 offered is strikingly low in the case of breast fed infants.

A slight increase in the average contamination of diet (Sr^{90}/gm Ca) with age is also found. The reason for it is to be found in the change in the quantitative composition of the diet with increasing age. The consumption of products which are relatively low in calcium, such as cereals and potatoes, increases while the consumption of calcium-rich products, especially milk, remains the same.

The mean contamination of food in the age groups examined was 13.6 μμc Sr^{90}/gmCa. This value is in good agreement with the results obtained from a direct determination of the mean contamination of the "normal" diet of adults. In this case the value obtained was 11.5 μμc Sr^{90}/gm Ca. This result shows that there is no significant difference between the contamination of the diet of children and juveniles and that of the diet of adults.

TABLE 1.—MEAN CONTAMINATION OF THE DIET OF CHILDREN AND JUVENILES IN GERMANY

[Concentrations in μμc Sr^{90}/gm Ca]

Age group (years)	Mother's milk feeding	Artificial feeding	Kraut's recommended diet[1]		Diet in a children's home		Diet of elementary and secondary school children		Diet in a boarding school		"Normal" diet of adults
0-1	7.0	10.9									
1-3			10.8								
4-6			11.4		9.6						
7-10			11.7		13.6		13.3				
			Female	Male	Female	Male	Female	Male	Female	Male	
11-14			12.2	12.8	14.2	14.7	14.4	14.0	12.5	12.1	
15-20			12.7	13.2	17.3	14.5	15.5	13.5	13.4	13.0	
>20											12

[1] "Recommended dietary allowances, by individual articles of food," Prof. Kraut.

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[1] Abstract prepared by Dr. Merten.

TABLE 2.—DAILY STRONTIUM-90 INTAKE BY CHILDREN AND JUVENILES IN GERMANY

[Concentrations in μμc/day]

Age group (years)	Mother's milk feeding	Artificial feeding	Kraut's recommended diet		Diet in a children's home		Diet of elementary and secondary school children		Diet in a boarding school		"Normal" diet of adults
0-1	4.2	8.0									
1-3			8.2								
4-6			9.4		5.9						
7-10			10.0		10.9		11.2				
			Female	Male	Female	Male	Female	Male	Female	Male	
11-14			10.8	11.2	8.2	11.9	11.3	14.3	8.7	13.3	
15-20			12.0	12.9	10.8	16.9	10.2	15.6	8.3	12.5	
>20											11.5

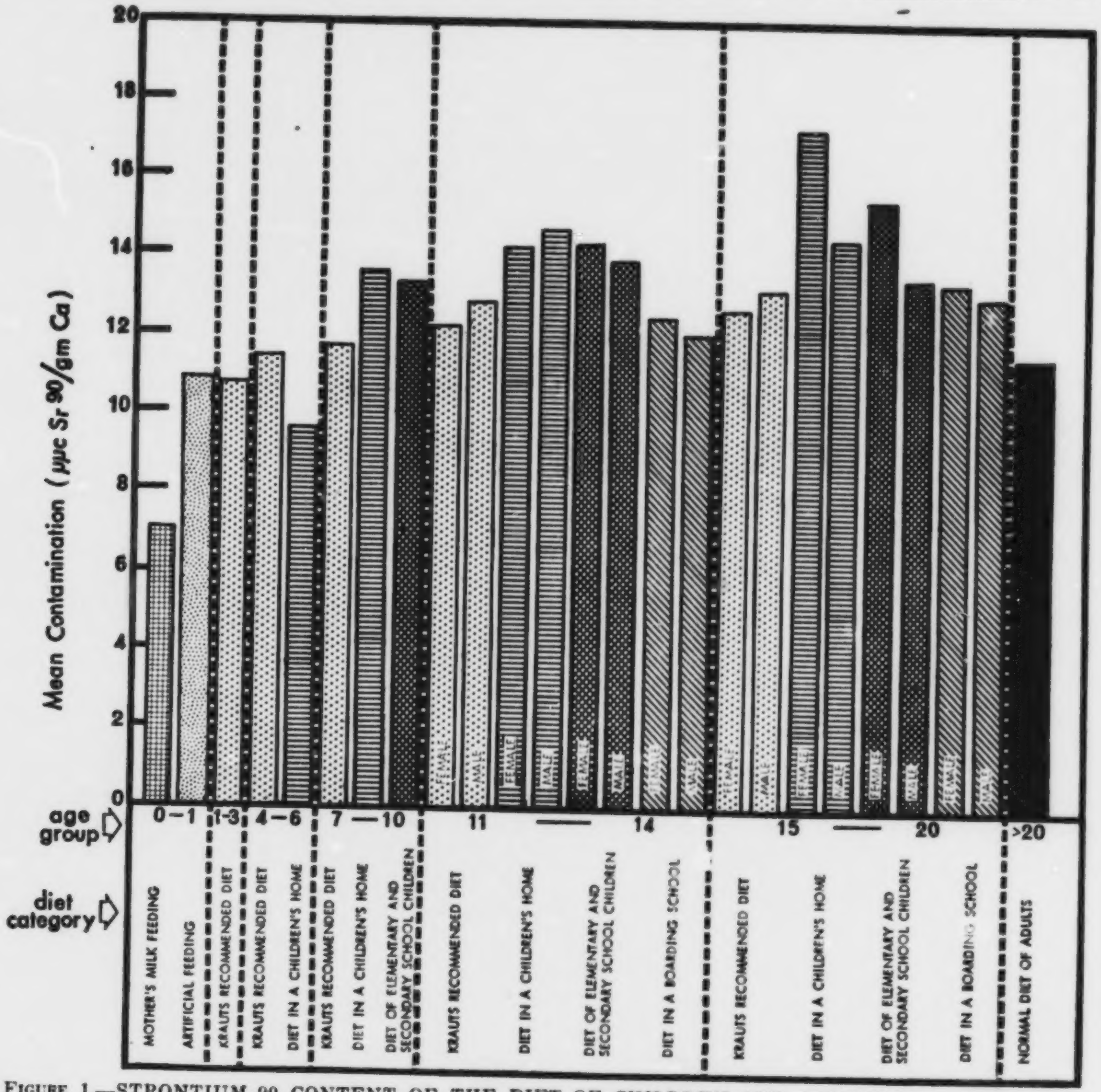

FIGURE 1.—STRONTIUM-90 CONTENT OF THE DIET OF CHILDREN AND JUVENILES IN THE FEDERAL REPUBLIC OF GERMANY DURING 1959

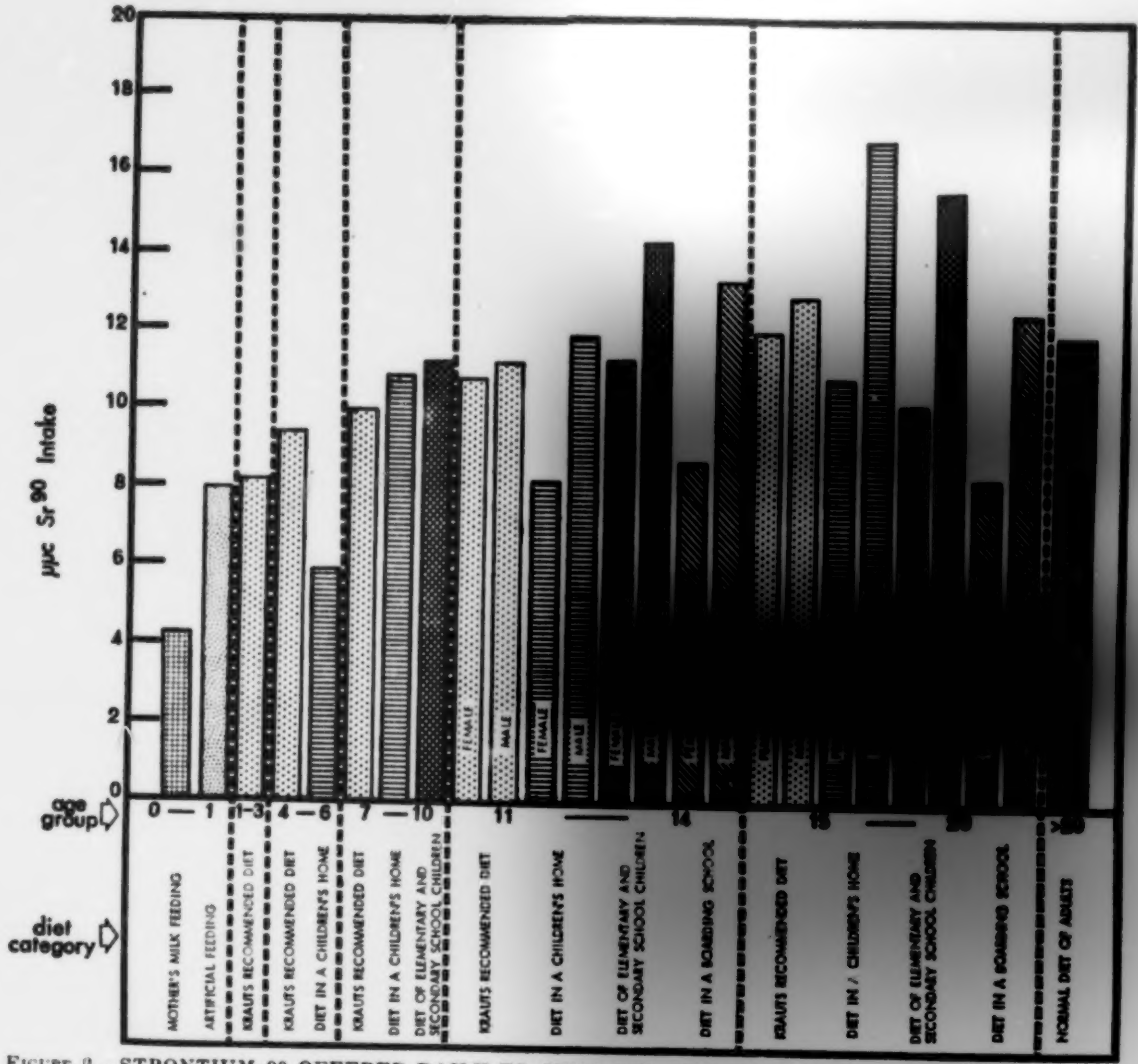

FIGURE 2.—STRONTIUM-90 OFFERED DAILY TO CHILDREN AND JUVENILES IN THE FEDERAL REPUBLIC OF GERMANY DURING 1959

SECTION III.—MILK

Radionuclides in Pasteurized Milk

February 1962

Division of Radiological Health
Division of Environmental Engineering and Food Protection
Public Health Service

Milk monitoring has been conducted by the Public Health Service since early 1957, when the first program was established to develop suitable sampling methods and radiochemical analytical procedures. Raw milk was initially selected for investigation. During this program, it became evident that a broader sampling program was necessary—one more directly related to the milk consumed by the population. The result was the initiation, in the first quarter of 1960, of a pasteurized milk sampling program designed to provide data representative of the milk consumed in selected municipalities. Both programs were reported concurrently until June 1961 to permit comparison of the differences between the earlier, limited, milkshed sampling results and those of the new program.

Raw milk sampling results reported for June 1961 in the November 1961 *Radiological Health Data (RHD)* were the last regular publication of such data. A summary discussion of the raw milk sampling program in the December 1961 *RHD* presented the gross relationship between fallout and the occurrence of fission products in milk as determined from this study.

During February 1962 the surveillance of pasteurized milk was conducted at 61 stations (shown in figure 1) with the cooperation of State and local milk sanitation agencies who ship samples to the PHS Southeastern and Southwestern Radiological Health Laboratories for analysis. The former analyzes samples from the 30 states generally east of the Mississippi River, and the latter analyzes samples from the western states. Publication in *RHD* follows about four months after sample collection because of time required for shipment, processing, decay-product buildup, data compilation, and publication procedures.

The current program emphasizes (1) measurement of the levels of radioactivity of samples of pasteurized milk consumed by the public in various regions of the country, and (2) provision of at least one sampling point within virtually all states and additional points when indicated by widely varying conditions of the milk supply or the need to cover large population groups. Each sample is composited in proportion to the volume of milk sold by those plants supplying not less than 90 percent of a city's milk supply. Prior to September 15, 1961, this composite sample was taken from one day's sales per month and was as representative

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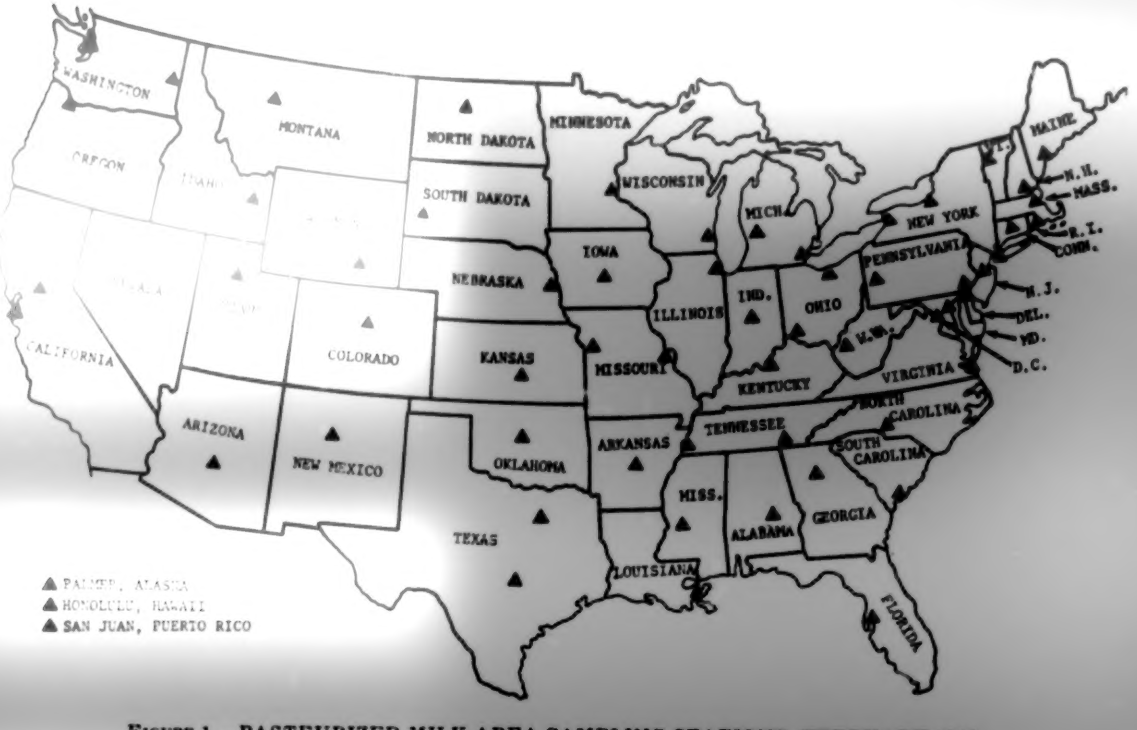

FIGURE 1.—PASTEURIZED MILK AREA SAMPLING STATIONS, FEBRUARY 1962

of a community's total supply as could be achieved under practical conditions. Since September 15, the sampling schedule has been accelerated.

During February 1962, sampling on a weekly basis was performed at most stations. All surveillance data is subject to continuing review and evaluation to observe unusual patterns or concentrations which may require immediate attention and adjustment in the pasteurized milk sampling program operation. Further atmospheric nuclear testing may require an immediate re-evaluation and readjustment of the sampling frequency and analytical schedule for this program.

Iodine-131, cesium-137, and barium-140 are determined by gamma scintillation spectroscopy, while strontium-89 and strontium-90 are determined following radiochemical separation. The minimum levels of detection for strontium-89, strontium-90, iodine-131, cesium-137, and barium-140 in terms of μμc/liter are 5, 1, 10, 5, and 10, respectively.

In the last two issues, *RHD* published graphical average monthly concentrations of strontium-90 in pasteurized milk from 12 selected cities of the monitoring network. This month, another eight cities are similarly treated in figures 2 and 3.

Figure 4 shows the February 1962 strontium-89 and strontium-90 concentrations plotted on an outline map of the United States.

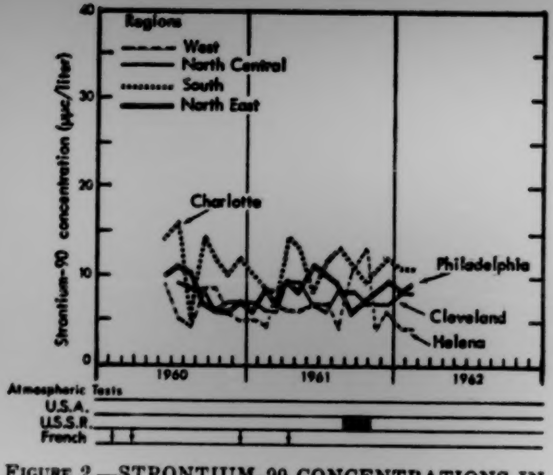

FIGURE 2.—STRONTIUM-90 CONCENTRATIONS IN PASTEURIZED MILK

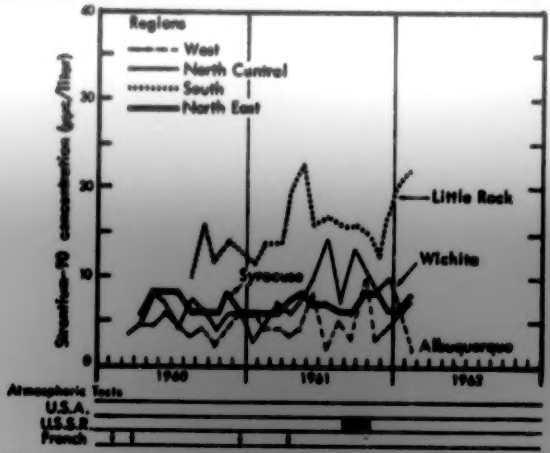

FIGURE 3. -STRONTIUM-90 CONCENTRATIONS IN PASTEURIZED MILK

Still evident, as during December and January, is the strontium-89 pattern of nearly nondetectable concentrations in the Northeastern and North Central States, low concentrations in the West, and higher concentrations in the South. This pattern, apparently, is due to the practice of feeding cattle during the winter on silage harvested prior to the resumption of atmospheric nuclear weapons testing while Southern dairy cattle were feeding on pasture contaminated by relatively fresh fission products containing strontium-89. While strontium-90 concentrations have increased at scattered locations in the South, the network average has remained nearly constant.

Table 1 presents a summary of all available analyses for February 1962. These data are an average of weekly samples in most instances. When radionuclides are not detectable, one-half the minimum levels of detection are used for averaging.

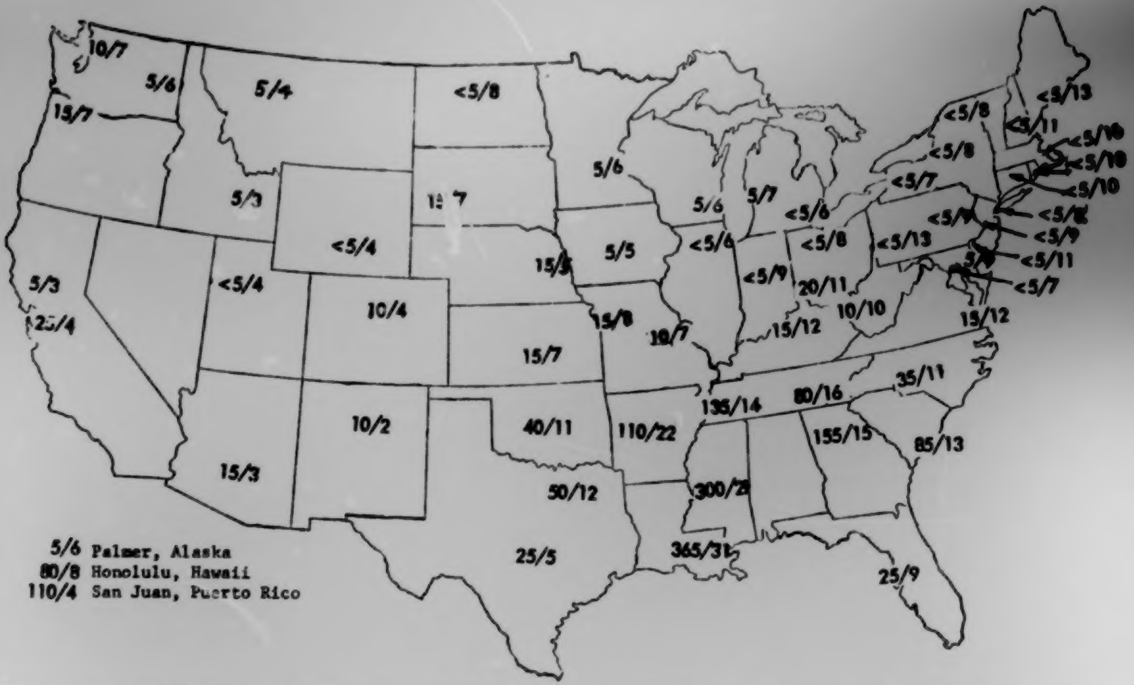

FIGURE 4.—STRONTIUM-89, STRONTIUM-90 CONCENTRATIONS (μμc/liter) IN PASTEURIZED MILK

TABLE 1.—RADIOACTIVITY IN PASTEURIZED MILK, FEBRUARY 1962

[Average radioactivity concentrations in $\mu\mu c$/liter]

Area		Calcium (gm/liter)		Strontium-89		Strontium-90		Iodine-131		Cesium-137		Barium-140	
City	State	Fourth quarter	Av. for month	Fourth quarter	Av. for month	Fourth quarter	Av. for month	Fourth quarter	Av. for month	Fourth quarter	Av. for month	Fourth quarter	Av. for month
Montgomery	Ala.	1.22	NS	10	NS	6	NS	20	<10	<5	20	20	NS
Palmer	Alaska	1.10	1.05	60	5	12	6	130	<10	15	10	40	10
Phoenix	Ariz.	1.05	1.06	10	15	6	3	50	<10	5	<5	<10	<10
Little Rock	Ark.	1.20	1.18	70	110	15	22	100	<10	20	20	30	10
Sacramento	Calif.	1.13	1.10	10	5	5	3	20	<10	10	<5	<10	<10
San Francisco	Calif.	1.09	1.14	10	25	3	4	20	<10	5	5	<10	<10
Denver	Colo.	1.10	1.10	20	10	6	4	50	10	10	5	10	10
Hartford	Conn.	1.17	1.11	25	<5	8	10	30	<10	10	10	30	<10
Wilmington	Del.	1.17	1.18	50	<5	11	11	40	<10	5	<5	30	<10
Washington	D. C.	1.17	1.18	35	<5	9	7	30	<10	5	<5	20	<10
Tampa	Fla.	1.22	1.24	20	25	6	9	30	<10	70	45	20	<10
Atlanta	Ga.	1.20	1.18	25	150	11	15	50	<10	[a] 5	35	20	20
Honolulu	Hawaii	1.07	1.04	10	80	6	8	20	<10	15	10	<10	<10
Idaho Falls	Idaho	1.05	1.10	25	5	6	3	80	20	10	10	10	10
Chicago	Ill.	1.18	1.16	50	<5	7	6	80	<10	[a] 10	<5	40	<10
Indianapolis	Ind.	1.21	1.20	40	<5	9	9	50	<10	<5	10	20	<10
Des Moines	Iowa	1.06	1.08	65	5	11	5	180	<10	10	10	20	<10
Wichita	Kans.	1.06	1.09	40	15	10	7	100	<10	10	<5	10	<10
Louisville	Ky.	1.19	1.16	45	15	11	12	60	<10	<5	<5	30	<10
New Orleans	La.	1.26	1.20	105	365	15	31	60	<10	15	65	40	40
Portland	Maine	1.19	1.17	60	<5	11	13	50	<10	20	<5	40	<10
Baltimore	Md.	1.17	1.17	35	5	8	9	40	<10	<5	5	20	<10
Boston	Mass.	1.18	1.18	70	<5	11	10	60	<10	10	<5	40	<10
Detroit	Mich.	1.17	1.14	40	<5	7	6	100	<10	5	<5	30	<10
Grand Rapids	Mich.	1.19	1.18	60	5	7	7	50	<10	<5	<5	30	<10
Minneapolis	Minn.	1.10	1.07	110	5	12	6	170	<10	15	10	40	10
Jackson	Miss.	1.28	1.26	95	300	14	21	70	<10	5	35	40	20
Rapid City	S. D.		1.12	80	15	16	7	60	<10	10	10	30	<10
Kansas City	Mo.	1.06	1.05	75	15	10	8	130	10	15	10	20	10
St. Louis	Mo.	1.08	1.07	35	10	9	7	90	<10	10	10	10	<10
Helena	Mont.	1.07	1.08	15	5	8	4	100	20	20	<5	10	10
Omaha	Nebr.	1.08	1.08	100	15	10	5	140	10	10	5	30	10
Manchester	N. H.	1.20	1.19	35	<5	12	11	50	<10	25	20	40	<10
Trenton	N. J.	1.19	1.17	35	<5	9	9	40	<10	<5	<5	20	<10
Albuquerque	N. Mex.	1.09	1.06	5	10	6	2	30	20	10	5	<10	20
Buffalo	N. Y.	1.12	1.12	35	<5	8	7	40	<10	5	<5	20	<10
New York	N. Y.	1.13	1.14	40	<5	8	8	50	<10	5	<5	30	<10
Syracuse	N. Y.	1.16	1.12	50	<5	7	8	60	<10	10	<5	40	<10
Charlotte	N. C.	1.27	1.18	25	35	11	11	20	<10	<5	<5	20	<10
Minot	N. D.	1.09	1.03	15	<5	11	8	60	<10	10	10	<10	<10
Cincinnati	Ohio	1.22	1.16	50	20	8	11	70	<10	<5	<5	30	<10
Cleveland	Ohio	1.18	1.15	35	<5	7	8	50	<10	5	<5	20	<10
Oklahoma City	Okla.	1.18	1.16	60	40	8	11	100	<10	10	<5	20	<10
Portland	Oreg.	1.05	1.07	70	15	17	7	80	<10	25	15	20	<10
Philadelphia	Pa.	1.20	1.20	30	<5	8	9	40	<10	<5	<5	20	<10
Pittsburgh	Pa.	1.16	1.18	40	<5	10	13	40	<10	5	<5	30	<10
San Juan	P. R.	1.18	1.12	55	110	6	4	20	<10	10	20	20	20
Providence	R. I.	1.18	1.15	55	<5	9	10	50	<10	10	<5	30	<10
Charleston	S. C.	1.22	1.22	15	85	11	13	30	<10	20	15	20	10
Chattanooga	Tenn.	1.27	1.24	50	80	12	16	50	<10	5	20	20	20
Memphis	Tenn.	1.24	1.23	60	135	11	14	90	<10	10	<5	20	20
Austin	Tex.	1.18	1.16	30	25	5	5	40	<10	[a]<5	<5	20	<10
Dallas	Tex.	1.23	1.20	45	50	9	12	50	<10	[a]<5	<5	20	<10
Salt Lake City	Utah	1.11	1.08	20	<5	5	4	60	10	10	5	10	<10
Burlington	Vt.	1.18	1.16	40	<5	9	8	50	<10	10	<5	30	<10
Norfolk	Va.	1.23	1.20	60	15	10	12	40	<10	5	<5	20	<10
Seattle	Wash.	1.11	1.09	60	10	13	7	80	<10	20	10	20	<10
Spokane	Wash.	[a]1.12	1.10	[a]10	5	[a] 6	6	60	<10	15	10	10	<10
Charleston	W. Va.	1.18	1.14	55	10	10	10	30	<10	<5	<5	20	<10
Milwaukee	Wis.	1.17	1.20	35	<5	7	6	80	<10	15	<5	30	<10
Laramie	Wyo.	1.09	1.05	<5	<5	6	4	30	10	15	10	10	<10
Network average		1.16	1.12	43	31	9	8.7	61	<10	11	9	22	<10

[a] Average based on two months.
[b] NS indicates no analysis made.

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SECTION IV.—WATER

National Water Quality Network

January 1962

Division of Water Supply and Pollution Control, Public Health Service

The National Water Quality Network operated in cooperation with State and local agencies and industrial organizations, commenced operations in October 1957. By the end of January 1962, 105 sampling stations were submitting water samples for analyses. These stations are located on major waterways used for public water supply, propogation of fish and wildlife, recreational purposes, and for agricultural, industrial, and other uses. Some of these stations are on interstate, coastal, and international boundary waters, and waters on which activities of the Federal Government may have an impact. Ultimately, a total of approximately 300 stations will be in operation. Radioactivity is not yet being reported for a few of the more recently established stations.

Samples of water are examined for chemical, physical, and biological quality insofar as these relate to pollution. Samples for some determinations are taken weekly, others monthly, and for some, continuous composite samples of 10 to 15 days are obtained.

Gross alpha and beta measurements are made on both suspended and dissolved solids (strontium-90 on the total solids only) in raw surface water samples. The levels of radioactivity associated with dissolved solids provide a rough measure of the levels which may be found in treated water, where such water treatment removes substantially all of the suspended matter. Naturally-occurring radioactive substances in the environment are the source of essentially all of the alpha activity. The contamination of the environment from man-made sources is the major contributor to the beta activity. It should be noted that with the cessation of weapons testing for a period of three years, the beta activity in most raw surface waters generally had approached a level attributable solely to natural sources. Natural beta activity can be two or three times the natural alpha activity based on the presence of the same nuclides. Since the resumption of nuclear weapons testing in the atmosphere, increased radioactivity of surface waters has been observed.

For the first two years of the Network operations, beta determinations were made on weekly samples. Alpha determinations were reported generally on composites of more than one weekly sample. Since January 1959, a portion of each sample from all stations in the Network has been composited into a three-month sample for measurement of strontium-90 concentration.

Beginning January 1, 1960, the frequency of beta determinations varied depending on the

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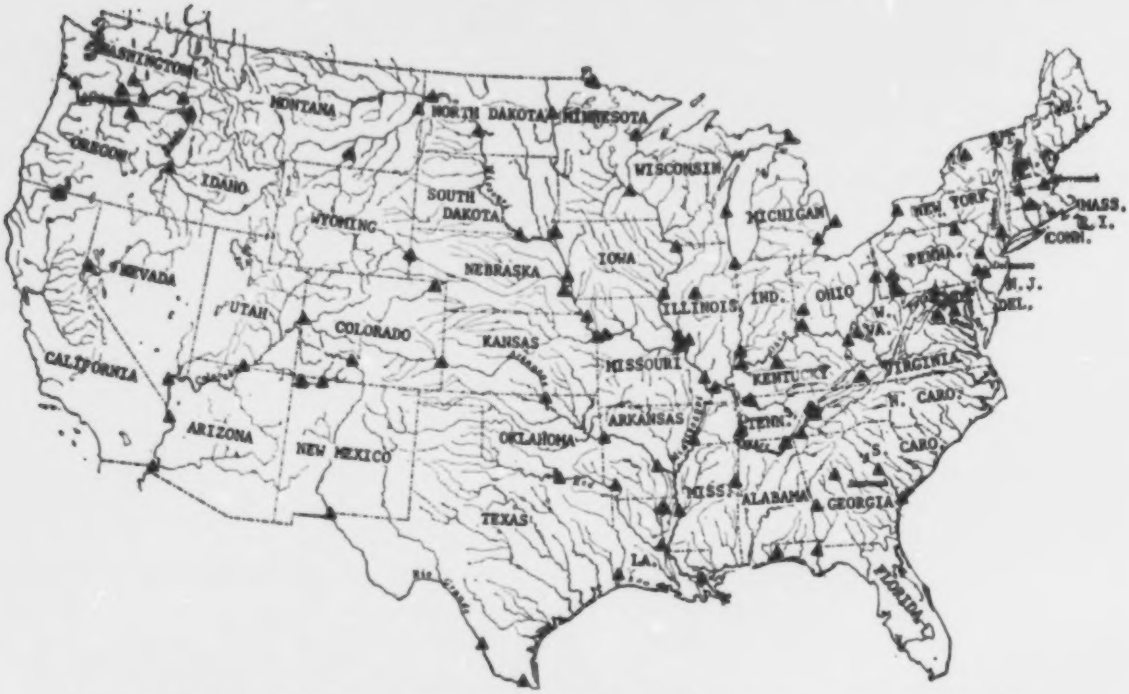

FIGURE 1.—NATIONAL WATER QUALITY NETWORK SAMPLING STATIONS, JANUARY 1962

status of each particular station. For the first operating year of each new station, analyses were being conducted weekly. Weekly analyses were to be continued indefinitely for all stations which may be affected by waste discharges from nuclear installations. Semimonthly determinations (on composites of 2 or 3 weekly samples) were conducted for stations which still showed some beta activity above background. Monthly determinations (on composites of all samples received from a station during the month) were conducted on samples from streams where beta activity was at background levels.

Beginning January 1, 1960, the frequency of alpha determinations also was changed. For the first operating year of each new station, analyses were to be done weekly. At some stations on the Colorado and Animas Rivers determinations were done on weekly samples or semimonthly on two-or three-week composites. The remainder of the stations were scheduled so that each made one gross alpha determination per month.

Following the resumption of nuclear weapons testing in the atmosphere by the U.S.S.R., the gross beta and alpha determination schedules were altered. Since September 1, 1961, gross beta determinations have been made on all samples collected. Since October 1, 1961, gross alpha determinations have been made on one sample from each station each month, unless there is evidence of alpha activity in excess of background levels. In the latter instance, an alpha determination has been made on a weekly or bi-weekly basis, depending on what is considered the norm for a particular station.

All data reported in table 1 represent the average of all data reported for the periods indicated. The reported strontium–90 data are the results of determinations on three-month composite samples for the quarter ending in the month shown.

Additional information and data may be obtained from the following sources:

National Water Quality Network Annual Compilation of Data, PHS Publication No. 663, Water Years 1957–58, 1958–59, 1959–60. Public Health Service, Division of Water Supply and Pollution Control, Washington 25, D. C.

TABLE 1.—RADIOACTIVITY IN RAW SURFACE WATERS

(Average concentrations in μμc/liter)

Station	Quarter ending Sept. 30, 1961	January 1962					
	Strontium-90	Beta activity			Alpha activity		
	Total	Suspended	Dissolved	Total	Suspended	Dissolved	Total
Allegheny River: Pittsburgh, Pa	0.3	—	—	—	—	—	—
Animas River: Cedar Hill, N. Mex	0.3	17	34	51	1	13	14
Apalachicola River: Chattahoochie, Fla	0.4	—	—	—	—	—	—
Arkansas river:							
Coolidge, Kansas	2.3	50	114	164	4	63	67
Ponca City, Okla	—	83	42	125	0	5	5
Pendleton Ferry, Ark	—	70	39	109	2	0	2
Big Horn River: Hardin, Mont	—	25	39	64	<1	8	8
Big Sioux River: Sioux Falls, S. Dak	0.4	73	43	113	2	3	5
Chattahoochie River:							
Atlanta, Ga	—	10	7	17	0	0	0
Columbus, Ga	—	37	16	53	0	0	0
Clear Water River: East Lewiston, Idaho	—	33	41	74	0	0	0
Colorado River:							
Loma, Colo	—	15	27	42	3	5	8
Page, Ariz	—	50	40	90	12	13	25
Boulder City, Nev	1.0	8	23	31	<1	7	7
Parker Dam, Calif	—	6	24	30	1	7	8
Yuma, Ariz	—	28	67	95	2	10	12
Columbia River:							
Wenatchee, Wash	—	6	8	14	0	0	0
Pasco, Wash	1.1	70	663	733	0	1	1
Bonneville Dam, Oreg	*0.6	58	332	390	0	<1	<1
Clatskanie, Oreg	—	25	110	135	—	—	—
McNary Dam, Oreg	1.2	41	290	331	0	1	1
Connecticut River:							
Northfield, Mass	0.4	11	25	36	0	0	0
Wilder, Vt	—	10	28	38	<1	0	<1
Cumberland River: Clarksville, Tenn	0.4	47	25	72	4	0	4
Delaware River:							
Martins Ck, Pa	—	31	37	68	0	0	0
Trenton, N. J	—	44	24	68	<1	0	<1
Escambia River: Century Fla	*0.9	34	17	51	0	0	0
Great Lakes							
Buffalo, N. Y	—	20	9	29	1	1	2
Detroit, Mich	*0.6	7	10	17	0	0	0
Port Huron, Mich	0.4	9	9	18	—	—	—
Milwaukee, Wis	—	6	7	13	0	0	0
Sault Ste. Marie, Mich	—	4	6	10	1	0	1
Gary, Ind	0.2	12	14	26	0	0	0
Duluth, Minn	—	6	7	13	0	0	0
Hudson River: Poughkeepsie, N. Y	0.2	17	30	47	0	0	0
Illinois River:							
Peoria, Ill	0.4	23	45	68	0	9	9
Grafton, Ill	—	35	43	78	4	1	5
Kanawha River: Winfield Dam, W. Va	—	10	10	20	0	0	0
Klamath River: Copco, Oreg	—	17	21	38	1	1	2
Little Miami River: Cincinnati, Ohio	1.1	84	54	138	2	0	2
Merrimack River: Lowell, Mass	*0.7	—	—	—	—	—	—
Mississippi River:							
St. Paul, Minn	0.9	8	18	26	1	0	1
Dubuque, Iowa	—	2	15	17	0	0	0
Burlington, Iowa	0.6	2	15	17	0	2	2
E. St. Louis, Ill	—	22	34	56	0	2	2
Cape Girardeau, Mo	0.8	68	26	94	0	2	2
West Memphis, Ark	—	53	33	86	2	<1	2
Delta, La	*0.4	91	35	126	4	1	5
New Orleans, La	—	29	27	56	4	1	5
Vicksburg, Miss	—	118	46	164	3	0	3
Missouri River:							
Williston, N. Dak	—	5	14	19	1	2	3
Bismarck, N. Dak	—	3	10	13	0	4	4
Yankton, S. Dak	0.6	10	26	36	1	4	5
Omaha, Nebr	—	8	24	32	0	5	5
St. Joseph, Mo	—	18	33	51	0	7	7
Kansas City, Kan	—	58	42	100	—	—	—
Missouri City, Mo	—	89	38	127	11	6	17
St. Louis, Mo	1.4	47	31	78	1	2	3
Monongahela River: Pittsburgh, Pa	0.4	6	23	29	0	0	0
North Platte River: Henry, Nebr	—	13	49	62	<1	35	35
Ohio River:							
East Liverpool, Ohio	0.4	—	—	—	—	—	—
Cincinnati, Ohio	—	26	18	44	1	0	1
Louisville, Ky	0.4	37	21	58	1	<1	1
Evansville, Ind	—	43	18	61	2	1	3
Cairo, Ill	1.1	80	25	105	5	1	
Ouchita River: Bastrop, La	—	68	75	143	1	<1	1
Platte River: Plattsmouth, Nebr	—	78	32	110	8	8	16
Potomac River:							
Williamsport, Md	—	20	14	34	1	0	1
Great Falls, Md	—	14	23	37	1	0	1
Rainy River:							
Baudette, Minn	—	5	7	12	0	0	0
International Fls, Minn	—	1	10	11	0	0	0
Red River, South:							
Index, Ark	—	128	48	176	0	1	1
Alexandria, La	1.0	49	39	88	1	1	2
Denison, Tex	—	8	22	30	1	0	1
Rio Grande River:							
Alamosa, Colo	*0.4	3	8	11	0	1	1

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TABLE 1.—RADIOACTIVITY IN RAW SURFACE WATERS

(Average concentrations in $\mu\mu c$/liter)

Station	Quarter ending Sept. 30, 1961	January 1962					
	Strontium-90	Beta activity			Alpha activity		
	Total	Suspended	Dissolved	Total	Suspended	Dissolved	Total
El Paso, Tex	—	32	42	74	4	8	12
Laredo, Tex	—	6	18	24	1	2	3
Brownsville, Tex	—	14	26	40	1	5	6
Roanoke River: John H. Kerr Resr. & Dam, Va	—	37	21	58	<1	0	<1
Sabine River: Ruliff, Tex	—	47	59	106	0	0	0
San Juan River: Shiprock, N. Mex	—	20	37	57	<1	12	12
St. Lawrence River: Massena, N. Y	—	10	12	22	—	—	—
Schuylkill River: Philadelphia, Pa	—	11	23	34	—	—	—
Savannah River:							
North Augusta, S. C	—	58	38	76	0	0	0
Port Wentworth, Ga	0.4	20	25	45	1	0	1
Shenandoah River: Berryville, Va	—	26	15	41	1	0	1
Snake River:							
Wawawai, Wash	0.3	14	18	32	0	3	3
Payette, Idaho	—	13	20	33	0	4	4
South Platte River: Julesburg, Colo	0.7	—	—	—	—	—	—
Susquehanna River:							
Sayre, Pa	0.3	18	26	44	0	0	0
Conowingo, Md	0.3	23	28	51	0	0	0
Tennessee River:							
Lenoir City, Tenn	—	65	26	91	2	1	3
Chattanooga, Tenn	0.6	34	49	83	1	0	1
Bridgeport, Ala	0.7	18	32	50	0	0	0
Pickwick Landing, Tenn	—	33	53	86	<1	0	<1
Tombigbee River: Columbus, Miss	—	111	43	154	2	0	2
Truckee River: Farad, Calif	—	9	10	19	<1	<1	1
Wabash River: New Harmony, Ind	—	224	57	281	5	3	8
Yakima River: Richland, Wash	0.4	9	10	19	<1	<1	1
Yellowstone River: Sidney, Mont	—	8	24	32	1	6	7

* April-September strontium 90 data.

"Report on National Water Quality Control Network," submitted by Dr. F. J. Weber, Chief, Division of Radiological Health, PHS, at the Joint Committee on Atomic Energy Hearings on Fallout from Nuclear Weapons Tests, 1: 167–169 (May 1959).

Setter, L. R., J .E. Regnier, and A. Diephaus, "Radioactivity of Surface Waters in the United States," *Journal of the American Water Works Association*, 51: 1377 (Nov. 1959).

Straub, C. P., L. R. Setter, A. Goldin, and P. F. Hallbach, "Strontium-90 in Surface Waters," *Journal of the American Water Works Association*, 52: 756 (June 1960).

Setter, L. R., and S. L. Baker, "Radioactivity of Surface Waters in the United States," *Radiological Health Data*, 1: 18–31 (Oct. 1960).

Straub, C. P., "Significance of Radioactivity Data," *Journal of the American Water Works Association*, 53: 704 (June 1961).

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SECTION V.—OTHER DATA

External Gamma Activity

April 1962

Division of Radiological Health, Public Health Service

Daily measurements of external gamma radiation are made at stations of the Radiation Surveillance Network to assure detection of any substantial deviations from normal background levels. Portable geiger-mueller survey instruments are used to obtain measurements at three feet above the ground surface. April 1962 data reported in table 1 are characteristic of individual station observations which in recent years have defined the range of normal background values.

TABLE 1.—EXTERNAL GAMMA ACTIVITY, APRIL 1962

Station location		Average (mr/hr)	Station location		Average (mr/hr)
City	State		City	State	
Adak	Alaska	0.01	Minneapolis	Minn	0.01
Anchorage	Alaska	0.01	Jackson	Miss	0.01
Attu	Alaska	0.01	Pascagoula	Miss	—
Cold Bay	Alaska	0.01	Jefferson City	Mo	0.01
Fairbanks	Alaska	0.01	Helena	Mont	0.03
Juneau	Alaska	0.01	Lincoln	Nebr	0.01
Kodiak	Alaska	0.01	Concord	N. H	—
Nome	Alaska	0.01	Trenton	N. J	0.02
Point Barrow	Alaska	0.01	Santa Fe	N. Mex	0.03
St. Paul Island	Alaska	0.01	Albany	N. Y	0.03
Phoenix	Ariz	0.09	Buffalo	N. Y	0.01
Little Rock	Ark	0.01	New York	N. Y	—
Berkeley	Calif	0.02	Gastonia	N. C	0.02
Los Angeles	Calif	0.02	Bismarck	N. D	0.01
Denver	Colo	0.02	Columbus	Ohio	0.01
Hartford	Conn	0.01	Painesville	Ohio	0.01
Washington	D. C	0.02	Oklahoma City	Okla	0.02
Jacksonville	Fla	0.01	Ponca City	Okla	0.03
Miami	Fla	0.01	Portland	Oreg	0.02
Atlanta	Ga	0.03	Harrisburg	Pa	0.01
Agana	Guam	(a)—	San Jaun	P. R	—
Honolulu	Hawaii	0.02	Providence	R. I	0.02
Boise	Idaho	0.02	Columbia	S. C	0.02
Springfield	Ill	0.01	Pierre	S. D	0.02
Indianapolis	Ind	0.02	Nashville	Tenn	0.01
Iowa City	Iowa	0.01	Austin	Tex	0.01
Topeka	Kans	0.02	El Paso	Tex	0.02
Frankfort	Ky	0.01	Salt Lake City	Utah	0.02
New Orleans	La	0.02	Barre	Vt	0.02
Augusta	Maine	0.02	Richmond	Va	0.01
Presque Isle	Maine	0.02	Seattle	Wash	0.02
Baltimore	Md	0.02	Madison	Wis	0.01
Lawrence	Mass	0.02	Cheyenne	Wyo	0.02
Winchester	Mass	0.02	Sundance	Wyo	—
Lansing	Mich	0.02			

[a] Dash denotes no data received.

ENVIRONMENTAL LEVELS OF RADIOACTIVITY AT ATOMIC ENERGY COMMISSION INSTALLATIONS

The U.S. Atomic Energy Commission receives from its contractors quarterly reports on the environmental levels of radioactivity in the vicinity of major Commission installations. The reports include data from routine monitoring programs where operations are of such a nature that plant perimeter surveys are required.

Various summaries of the environmental radioactivity data for 18 AEC installations have appeared in *Radiological Health Data* since November 1960. Summaries follow for Feed Materials Production Facilities (Third and fourth quarters 1961) and Pinellas Peninsula Plant (calendar years 1960 and 1961).

The measured concentration of a radionuclide in air and water may be compared with the Maximum Permissible Concentration (MPC) of that nuclide as recommended by the National Committee on Radiation Protection and Measurement (NCRP)*. For the environment near an AEC installation, the applicable MPC's are one-tenth of the occupational MPC values for continuous exposure given in National Bureau of Standards "Handbook 69." The MPC values applicable to the following reports are given in table 1.

TABLE 1.—SELECTED ENVIRONMENTAL MPC VALUES PERTAINING TO AEC INSTALLATION REPORTS IN THIS SUBSECTION

Line no.	Radionuclide or mixture of radionuclides	Environmental MPC's	
		Water ($\mu\mu c$/liter)	Air ($\mu\mu c/m^3$)
1	Uranium (natural)	20,000	2
2	Tritium oxide ($H^3{}_2O$)	3,000,000	200,000
3	Tritium gas ($H^3{}_2$)	----------	40,000,000

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* The Federal Radiation Council has not published radioactivity concentration guides for uranium and tritium.

Feed Materials Production Facilities

Third and Fourth Quarters 1961

Malinckrodt Chemical Works
Weldon Spring, Missouri

Environmental monitoring results at the Feed Materials Production Facilities (FMPF), Weldon Spring, Missouri, are expressed in special uranium microcuries since uranium ore concentrates constitute the primary feed material. As defined in the National Bureau of Standards "Handbook 69," the units of concentration in this report are based on a curie of recently extracted uranium equal to the sum 3.7×10^{10} d/s from U–238, 3.7×10^{10} d/s from U–234, and 9×10^{8} d/s from U–235.

Process chemical wastes and other process residues are permanently retained in storage facilities located at both the site and two storage sites located adjacent to the Lambert-St. Louis Municipal Airport and at a quarry near the Missouri River (see figure 1). The plant process sewer, which carries the remaining water effluent from the operations into the Missouri River, is automatically sampled daily to permit continual measurement of any release of uranium-bearing material into the river. Off-site water samples are also collected from lakes, creeks, and rivers located within the plant's watershed. Air samples are collected on-site along the plant perimeter fence and on building roofs.

Third and fourth quarter results and the annual summary data that follow indicate that the average release of uranium-bearing materials from FMPF during 1961, as in the previous year, was substantially below the MPC for nonoccupational areas for natural uranium. The average uranium concentration found in off-site samples collected during the Fourth quarter 1961 decreased slightly from

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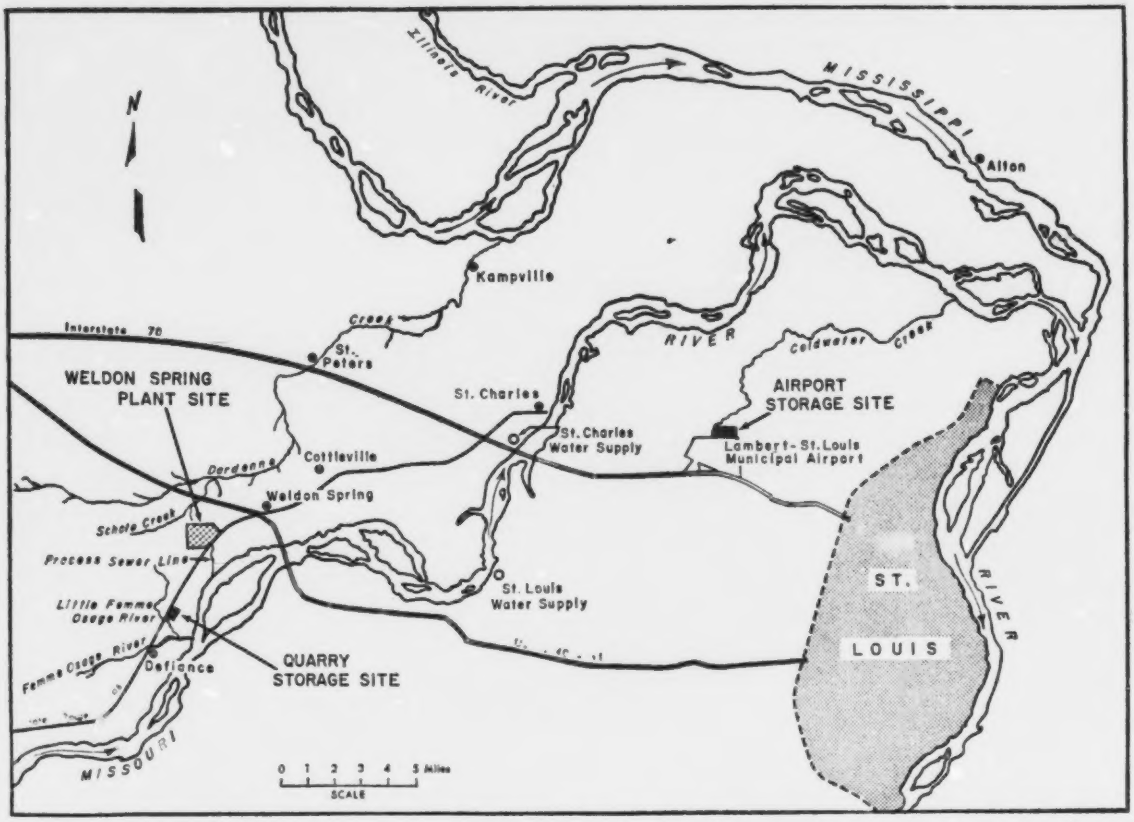

FIGURE 1.—LOCATION OF FEED MATERIALS PRODUCTION FACILITIES, WELDON SPRING, MISSOURI

TABLE 2.—URANIUM CONCENTRATIONS IN AIR

[Average uranium concentrations in $\mu\mu c/m^3$]

On-site sample location			Third quarter 1961		Fourth quarter 1961	
Site	Position	Direction from plant	Number of samples	Uranium concentration	Number of samples	Uranium concentration
Plant	Fence line	Northeast	2	0.189	3	0.029
	Roof	East	3	0.015	3	0.376
	Fence line	North	3	0.044	3	0.009
	Roof	Northwest	3	0.082	3	0.644
	Open area	Southwest	3	0.010	3	0.004
	Roof	Southeast	3	0.106	3	0.502
	Not reported	South-southwest	1	0.040	3	0.038
	Not reported	West	2	0.089	3	0.068
	Not reported	North-northwest	2	0.055	3	0.021
	Average			0.070		0.188
Quarry	Edge of quarry	South	2	0.019	2	0.082
Airport	4 locations	3 North, 1 South	7	0.049	5	0.010

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TABLE 3.—URANIUM CONCENTRATIONS IN WATER

[Average concentrations in $\mu\mu c$/liter]

Sampling locations	Third quarter 1961		Fourth quarter 1961	
	Number of samples	Uranium concentration	Number of samples	Uranium concentration
Process sewer, plant site	61	230	59	530
Missouri River sampling points:				
Defiance, upstream	3	10	3	1
Femme Osage junction, upstream	2	3	3	<2
Process sewer outfall	3	110	3	110
U. S. Highway 40-61, north side	3	2	3	7
U. S. Highway, 40-61, south side	3	1	3	2
St. Louis City water plant intake	3	1	3	2
St. Charles City water plant intake	3	1	3	<2
Plant off-site sampling points:				
Lake across from plant entrance	3	1	3	<2
Lake, east of plant	3	1	3	1
Lake, north of plant	3	2	3	<2
Lake, west of plant	3	1	3	1
Dardene Creek, upstream	3	<1	3	<1
Dardene Creek, Cottleville, Bridge	3	7	3	5
Dardene Creek, St. Peters	3	3	3	6
Dardene Creek, Kampville	3	4	3	3
Schote Creek, upstream	3	2	3	21
Schote Creek, downstream	3	20	3	1
Plant surface drainage, west	3	78	3	160
Plant surface drainage, north	3	17	3	280
Quarry off-site sampling points:				
Little Femme Osage (LFO), ½ mile upstream	2	3	3	1
Branch, LFO, ½ mile upstream	2	1	3	2
LFO, at quarry discharge culvert	2	5	3	5
LFO, ¼ mile downstream	2	1	3	<1
LFO, 1¼ mile downstream	2	1	3	2
Airport off-site sampling points:				
Cold Water Creek, adjacent to site	3	2	3	1
Drainage ditch, north of site	1	400	1	70

TABLE 4.—REVIEW OF URANIUM CONCENTRATIONS IN THE ENVIRONMENT OF FMPF, WELDON SPRING MISSOURI, 1960-1961

[Average concentrations in percent of appropriate MPC's][1]

Source of possible contamination	Sampling type and location	Calendar year 1960	Calendar year 1961	1961			
				First quarter	Second quarter	Third quarter	Fourth quarter
Plant site	Air plant perimeter	9.6	11.4	37.0	3.2	3.2	9.4
	Water, process sewer	4.2	1.7	1.7	1.0	1.1	2.6
	Water, Missouri River downstream	0.22	0.19	0.55	0.10	0.10	0.12
	Water, streams and ditches	0.33	0.48	0.80	0.16	0.60	0.30
	Water, lakes	0.11	<0.02	0.02	0.01	<0.01	<0.01
Quarry storage site	Air, south edge		2.2	2.8	1.7	0.9	4.0
	Water, streams	0.02	<0.02	0.01	0.02	0.01	0.01
Airport storage site	Air, site perimeter	0.78	1.6	—	2.4	—	0.5
	Water, streams and ditches	0.15	0.30	—	0.5	—	0.09

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[1] Environmental MPC's for uranium as given in NBS Handbook 69, page 86, are 2 $\mu\mu c/m^3$ for air and 20,000 $\mu\mu c$/liter for water.

samples collected during the third quarter. However, over the year a 1.7 percent increase is evident from comparison of percent MPC values for 1960 and 1961.

Air Monitoring

Monthly air samples are collected on-site along the plant perimeter and on building roofs by six high volume sampling pumps. During 1961, monthly samples were also collected by three windmill sampling pumps located south-southwest, west, and north-northwest of the plant. Semiannual air samples are collected at four points on the perimeter of the airport storage site, and monthly air samples were begun during the first quarter of 1961 at the south edge of the quarry. Third and fourth quarter air data are reported in table 2 and incorporated with review data in table 4.

Water Monitoring

In addition to daily samples from the plant process sewer, monthly off-site water samples are collected from lakes and streams located within the plant's watershed, the Missouri River, and streams near the quarry at the points indicated in table 3.

Previous Coverage in Radiological Health Data

Periods covered	*Issues*
1959 and First Quarter 1960	November 1960
Third and Fourth Quarters 1960	November 1961
First and Second Quarters 1961	November 1961

Pinellas Peninsula Plant

January 1960–December 1961

General Electric Company
St. Petersburg, Florida

Environmental monitoring at the Pinellas Peninsula Plant (PPP) includes sampling of a single combined sewer effluent, several local dairy farms, and air, water, and vegetation obtained at locations suggested by meteorological conditions and radioactivity discharge concentrations. With the exception of air, which may include tritium gas, the radioactivity content in samples is tritium oxide

No air samples were collected during the first three quarters of 1961. During 1960 and the fourth quarter 1961, air sampling revealed no detectable concentrations of tritium gas or tritium oxide. Occasionally the tritium concentrations in the combined sewer effluent were detectable. There were no indications of tritium in milk, vegetation, or other water samples analyzed.

Environmental monitoring data for both years indicate that radioactivity discharges from the Pinellas Peninsula Plant have negligible effects on the environment.

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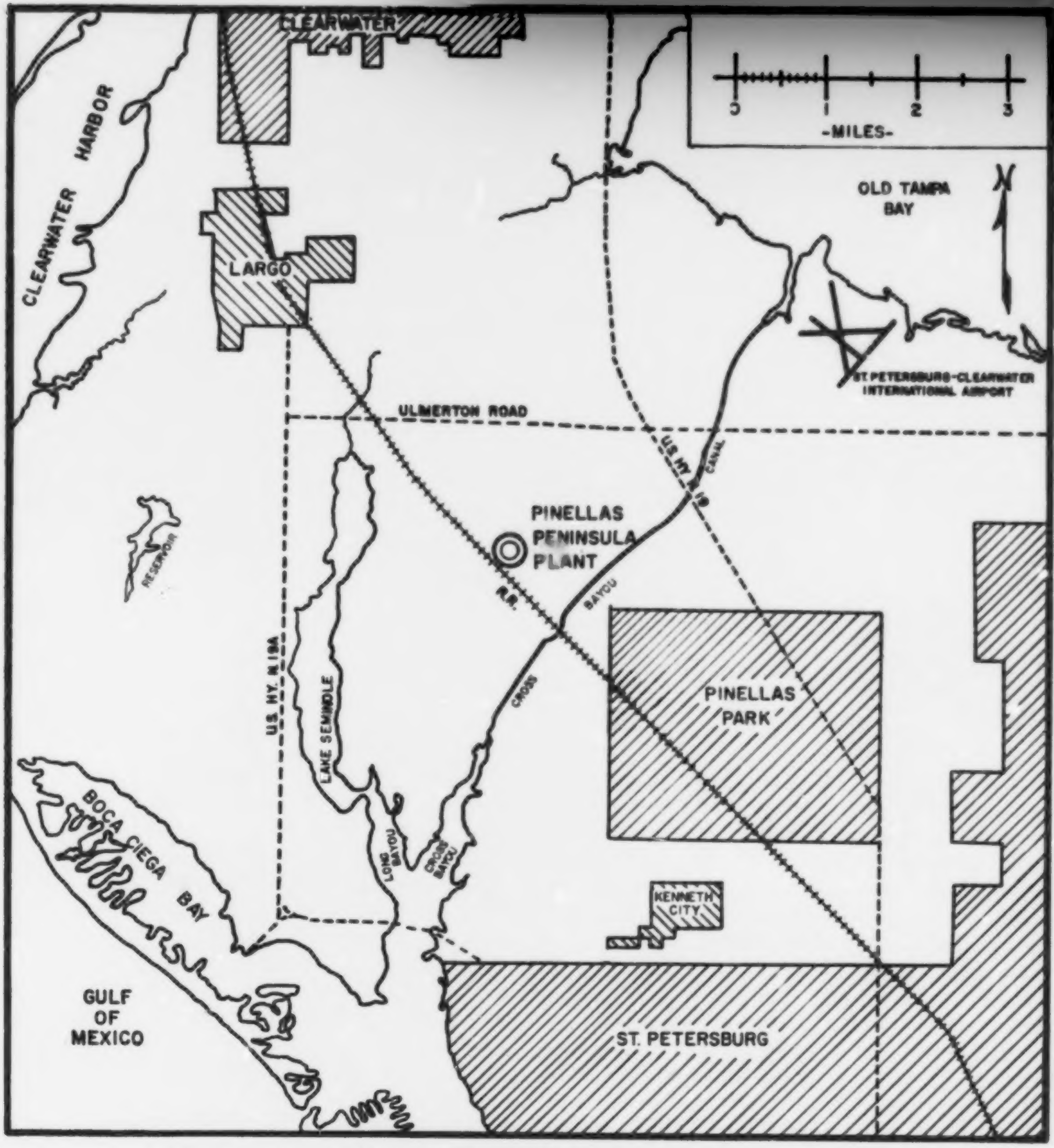

FIGURE 1.—LOCATION OF THE PINELLAS PENINSULA PLANT SITE

TABLE 1.—TRITIUM CONCENTRATIONS AT THE PINELLAS PENINSULA PLANT

Sampling details		1960	1961	
			First-third quarters	Fourth quarter
Plant sewer effluent (μμc/liter)	Number of samples	235	166	58
	Average concentration	<110,000	<110,000	<110,000
	Maximum concentration	480,000	180,000	<110,000
Surface water (μμc/liter)	Number of samples (0-6 miles from plant)	331	164	32
	Average concentration	<110,000	<110,000	<110,000
	Maximum concentration	<110,000	<110,000	<110,000
Vegetation (μμc/kg)	Number of samples (0-6 miles from plant)	518	285	56
	Average concentration	<500,000	<500,000	<500,000
	Maximum concentration	<500,000	<500,000	<500,000
Raw milk (μμc/liter)	Number of samples (1-5 miles from plant)	15	30	15
	Average concentration	<110,000	<110,000	<110,000
	Maximum concentration	<110,000	<110,000	<110,000
Air: Tritium gas (μμc/m³)	Number of samples (0-2 miles downwind from plant)	29	0	6
	Average concentration	<3,000,000	—	<1,300,000
	Maximum concentration	<3,000,000	—	<1,300,000
Tritium oxide (μμc/m³)	Number of samples (0-2 miles downwind from plant)	Included in tritium gas measurements	0 —	11 <2,000
	Average concentrations			<2,000
	Maximum concentrations		—	<2,000

Reported Nuclear Detonations

June 1962

Since October 1961, summary information on all known nuclear detonations during the month preceding publication have been regularly reported in this section of *Radiological Health Data*. As the May and June issues of *RHD* inadvertently skipped numbers in the consecutive numbering sequence, the table below recapitulates all tests through March with revised test numbers, including tests conducted during June 1962.

On June 9, 1962, Joint Task Force 8 announced the temporary extension of the Johnston Island test area in the Pacific for the next high altitude test in the megaton range because of the expected intensity of light from the detonation.

The area remained circular in shape with the radius extended to 530 nautical miles at the surface, using Johnston Island coordinates (16° 45′ North, 169° 31′ West) as its center. The radius increased gradually to 1050 nautical miles at 40,000 feet. This represented an increase of 60 nautical miles at the surface and 350 nautical miles at 40,000 feet. The enlargement of the Johnston Island area took effect on June 12.

REPORTED NUCLEAR DETONATIONS BY THE UNITED STATES, MARCH–JUNE 1962

Test number	Location	Date	Yield range*	Type of test
20	Nevada Test Site	March 5	Low	Underground.
21	Nevada Test Site	March 6	Low	Underground.
22	Nevada Test Site	March 8	Low	Underground.
23	Nevada Test Site	March 15	Low	Underground.
24	Nevada Test Site	March 28	Low	Underground.
25	Nevada Test Site	March 31	Low	Underground.
26	Nevada Test Site	April 5	Low	Underground.
27	Nevada Test Site	April 6	Low	Underground.
28	Nevada Test Site	April 12	Low	Underground.
29	Nevada Test Site	April 14	Low	Underground.
30	Nevada Test Site	April 21	Low	Underground
31	Christmas Island, Pacific	April 25	Intermediate	Atmospheric.
32	Christmas Island, Pacific	April 27	Intermediate	Atmospheric.
33	Nevada Test Site	April 27	Low	Underground.
34	Christmas Island	May 2	Low megaton	Atmospheric.
35	Christmas Island	May 4	Intermediate	Atmospheric.
36	Christmas Island	May 6	Not announced	Nuclear warhead in missile launched from Polaris submarine.
37	Nevada Test Site	May 7	Low	Underground.
38	Christmas Island	May 8	Intermediate	Atmospheric.
39	Christmas Island	May 9	Intermediate	Atmospheric.
40	Christmas Island	May 11	Intermediate	Atmospheric
41	Christmas Island	May 11	Low	Underwater.
42	Nevada Test Site	May 12	Intermediate	Underground.
43	Christmas Island	May 12	Intermediate	Atmospheric.
44	Christmas Island	May 14	Intermediate	Atmospheric.
45	Christmas Island	May 19	Intermediate	Atmospheric.
46	Nevada Test Site	May 19	Low	Underground.
47	Nevada Test Site	May 25	Low	Underground.
48	Christmas Island	May 25	Low	Atmospheric.
49	Christmas Island	May 27	Intermediate	Atmospheric.
50	Nevada Test Site	June 1	Low	Underground.
51	Nevada Test Site	June 6	Low	Underground.
52	Christmas Island	June 8	Intermediate	Atmospheric.
53	Christmas Island	June 9	Intermediate	Atmospheric.
54	Christmas Island	June 10	Low megaton	Atmospheric.
55	Christmas Island	June 12	Intermediate	Atmospheric.
56	Nevada Test Site	June 13	Low	Underground.
57	Christmas Island	June 15	Intermediate	Atmospheric.
58	Christmas Island	June 17	Intermediate	Atmospheric.
59	Christmas Island	June 19	Low	Atmospheric.
60	Nevada Test Site	June 21	Low	Underground.
61	Christmas Island	June 22	Intermediate	Atmospheric.
62	Nevada Test Site	June 27	Intermediate	Underground.
63	Christmas Island	June 27	Megaton	Atmospheric.
64	Nevada Test Site	June 28	Low	Underground.
65	Christmas Island	June 30	Low megaton	Atmospheric.
66	Nevada Test Site	June 30	Low	Underground.

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* Low yield range has been announced as meaning about a nominal (20 kiloton) yield; intermediate yield meaning the range between nominal and one megaton; and low megaton meaning more than one, but less than 5 megatons.

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VOLUME III, NUMBER 8
AUGUST 1962

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U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service ● Division of Radiological Health

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ADVANCE REPORT

The Public Health Service Pasteurized Milk Network July monthly tabulations of 61 stations show an average daily iodine-131 concentration of 40 micromicrocuries per liter during July. Monthly average concentrations of more than 20 μμc/liter were noted at 21 stations. Of the 61 stations, only 2 averaged more than 80 μμc/liter per day. These were Salt Lake City with 580 μμc/liter and Laramie, Wyoming, with 370 μμc/liter. These elevated levels of iodine-131 occurred during the last 2 weeks of July with a daily high value of 2,050 μμc/liter in Salt Lake City on July 25.

As a precaution against possible continued high iodine-131 levels, Salt Lake City and State of Utah health officials, working with the dairy industry, initiated limited control measures through management of the milk supply on August 1. The situation will permit them to determine the effectiveness of controlling the general iodine levels by diverting milk from parts of the milkshed with highest iodine-131 levels into manufactured milk products and milk from milksheds with lower iodine levels into the pasteurized fluid milk used daily in the Salt Lake City area.

Editor's note: The above information is preliminary and subject to further confirmation. It summarizes recent data submitted to the Radiation Surveillance Center, Division of Radiological Health, Public Health Service.

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SECTION I.—AIR AND PRECIPITATION

Fission Product Beta Activity in Airborne Particulates and Precipitation

Measurements of gross beta activity of airborne particulates and precipitation are among the earliest and most sensitive indicators of increases of fission product activity in the environment. However, a direct evaluation of biological effects is not possible from these data alone.

Of the several networks or sampling programs making such measurements the Radiation Surveillance Network and the Naval Research Laboratory are represented in the following reports.

RADIATION SURVEILLANCE NETWORK

May 1962

Division of Radiological Health, Public Health Service

The Public Health Service Radiation Surveillance Network (RSN) was established in 1956 in cooperation with the Atomic Energy Commission to provide a means of promptly determining increasing levels of radioactivity in air and precipitation due to fallout from nuclear weapons tests. Prior to September 1961, the Network consisted of 45 stations. Following the September 1961 resumption of nuclear weapons testing by the U.S.S.R., the Network has been expanded over a period of several months to 72 stations, whose locations are shown in figure 1.

Air

Daily 24-hour air samples are collected by a high volume air sampler with a 4-inch diameter carbon-loaded cellulose dust filter. Field measurements with a portable survey meter enable the station operator to estimate the amount of beta activity in airborne particulates at the station five hours after collection by comparison with a known Sr^{90}–Y^{90} source. This 5-hour delay eliminates interference from naturally-occurring radon daughters. Each operator then reports his field estimate by telephone to the Radiation Surveillance Center, Division of Radiological Health in Washington, D. C., to provide a daily national alert report.

The filters are then forwarded to the Radiation Surveillance Network Laboratory in Rockville, Maryland, for a more refined measurement using a thin-window gas-flow proportional counter. Each filter is counted at least three days after the end of the sampling period and re-counted seven days later. The initial three-day aging of the sample eliminates interference from naturally-occurring radon and

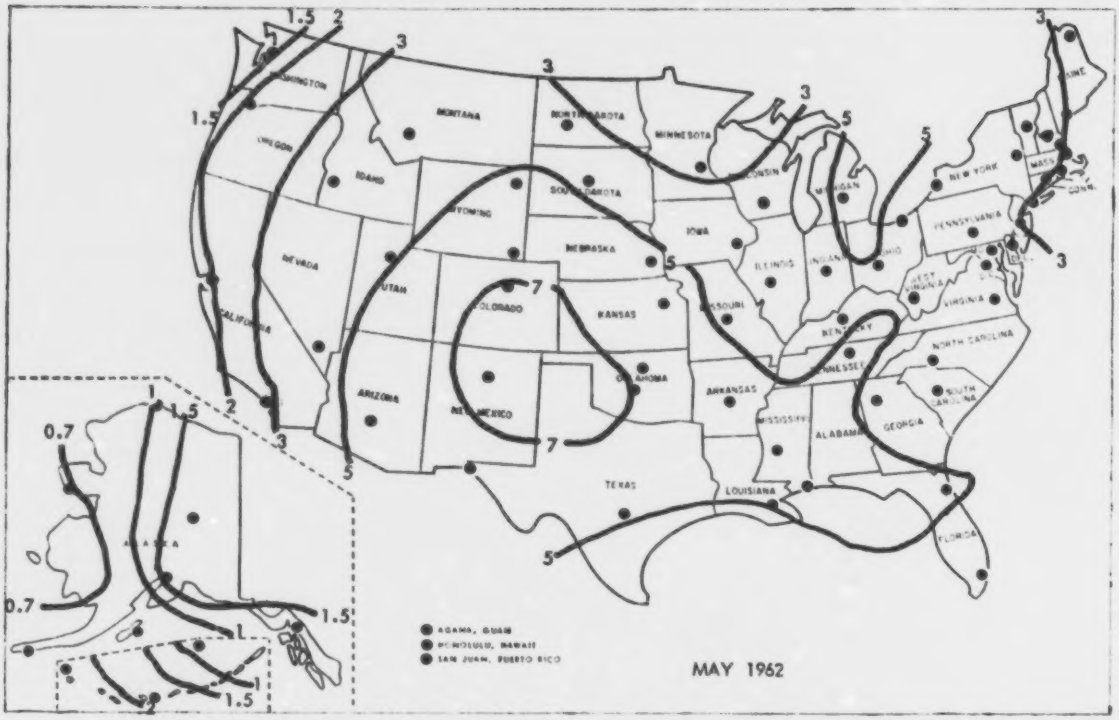

FIGURE 1.—RADIATION SURVEILLANCE NETWORK SAMPLING STATIONS AND AVERAGE FISSION PRODUCT BETA CONCENTRATIONS IN AIR ($\mu\mu c/m^3$) MAY 1962

thoron daughters. The two counts, separated by a seven-day interval, make possible the estimation of an effective age of fission products and extrapolation of the activity to the time of collection. The extrapolation is performed by using the Way-Wigner formula ($AT^{1.2} =$ constant).*

The average fission-product beta concentrations in surface air during May 1962 as determined by laboratory analysis are tabulated in table 1 and presented by means of iso-concentration contours in figure 1. Experience has shown that field estimates are generally comparable to laboratory analyses, except at low levels, where the former are usually higher because of natural radon and thoron daughters.

Precipitation

Continuous sampling for total precipitation is conducted at most stations on a daily basis using funnels having collection areas of 0.4 square meter. A 500-ml aliquot of the collected precipitation is evaporated to dryness, and the residue is forwarded to the laboratory to be counted by the same method used for analyzing the air samples. If the collected sample is between 200 and 500 ml, the entire sample is evaporated; if less than 200 ml, the volume of precipitation is reported, but no analysis is made.

The May 1962 averages of gross beta activity in precipitation, expressed in micromicrocuries per liter ($\mu\mu c$/liter) and micromicrocuries per square meter ($\mu\mu c/m^2$) are presented in table 2. Placement of a "less than" sign (<) with an average concentration or total deposition value indicates that the sum of the "less than" daily deposition values is 10% or more of the total deposition so that the true total or average is considered significantly less than the value shown.

Profiles

The profiles of the monthly average fission product beta activity in airborne particulates for each RSN station covering the period of time from the formation of the network in 1956 to the end of 1960 were published in *RHD*, July 1961. The profiles of seven stations, updated through May 1962, are shown in figure 2.

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* In this expression, A is the activity at time T after fission product formation. Units are arbitrary.

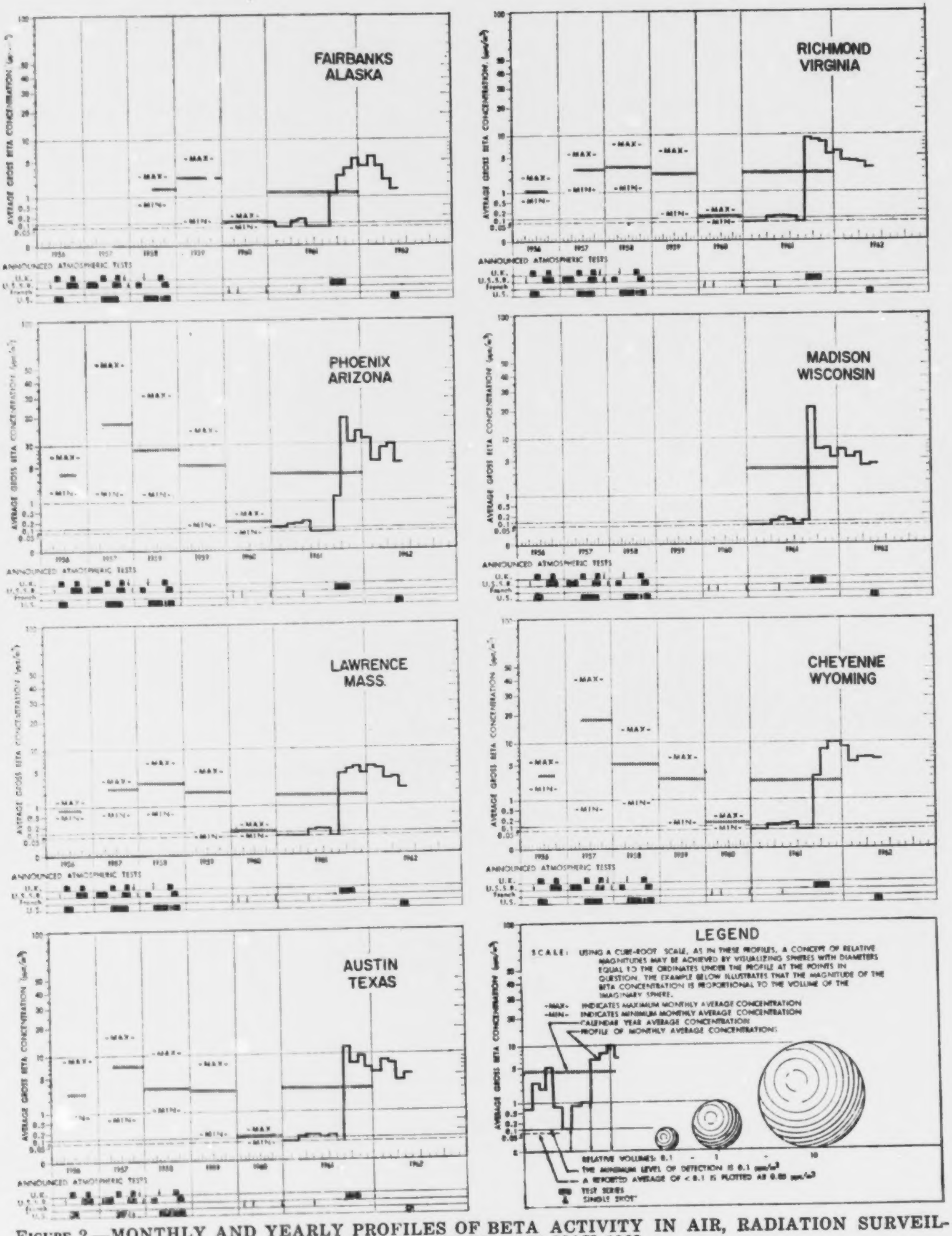

FIGURE 2.—MONTHLY AND YEARLY PROFILES OF BETA ACTIVITY IN AIR, RADIATION SURVEILLANCE NETWORK, 1956–MAY 1962

TABLE 1.—GROSS BETA ACTIVITY OF PARTICULATES IN AIR, RSN, MAY 1962

[Concentrations in $\mu\mu c/m^3$]

Station location		Number samples	Maximum	Minimum	Average[a]
City	State				
Adak	Alaska	31	6.2	0.15	1.6
Anchorage	Alaska	31	3.5	0.12	1.6
Attu	Alaska	33	9.5	0.35	2.6
Cold Bay	Alaska	3	3.0	2.6	2.8
Fairbanks	Alaska	31	4.1	<0.10	1.6
Juneau	Alaska	23	3.0	<0.10	1.4
Kodiak	Alaska	28	2.4	<0.10	0.88
Nome	Alaska	17	1.6	<0.10	0.70
Point Barrow	Alaska	25	1.8	0.38	1.0
St Paul Island	Alaska	31	2.2	<0.10	0.73
Phoenix	Ariz	30	9.5	2.0	5.6
Little Rock	Ark	30	7.8	3.0	5.4
Berkeley	Calif	20	3.7	0.56	2.0
Los Angeles	Calif	26	6.6	0.84	2.9
Denver	Colo	30	31.0	1.0	7.4
Hartford	Conn	31	5.0	0.29	3.0
Dover	Del	17	5.4	2.3	4.0
Washington	D. C	31	4.7	0.25	3.3
Jacksonville	Fla	31	7.6	2.5	5.0
Miami	Fla	29	6.6	2.1	4.5
Atlanta	Ga	28	6.7	1.2	3.6
Agana	Guam	22	5.0	0.42	2.3
Honolulu	Hawaii	29	2.7	0.45	1.3
Boise	Idaho	29	7.8	<0.10	3.7
Springfield	Ill	31	6.4	1.8	3.9
Indianapolis	Ind	31	6.0	1.9	4.0
Iowa City	Iowa	31	7.0	1.3	3.8
Topeka	Kans	30	10.0	2.1	5.3
Frankfort	Ky	28	7.1	1.7	3.8
New Orleans	La	31	7.0	1.9	5.0
Augusta	Maine	30	5.9	0.31	2.9
Presque Isle	Maine	31	5.2	0.57	2.7
Baltimore	Md	31	6.6	0.54	4.0
Lawrence	Mass	30	5.7	0.16	2.5
Winchester	Mass	30	5.1	0.19	2.5
Lansing	Mich	31	9.0	2.9	5.5
Minneapolis	Minn	31	3.4	0.35	2.9
Jackson	Miss	31	8.3	2.4	5.6
Pascagoula	Miss	23	9.6	2.7	6.6
Jefferson City	Mo	31	6.1	1.9	4.6
Helena	Mont	31	8.4	0.15	3.4
Lincoln	Nebr	30	8.6	2.3	5.5
Las Vegas	Nev	20	9.0	2.8	4.8
Concord	N. H	22	8.0	0.22	3.9
Trenton	N. J	30	5.1	0.27	2.7
Santa Fe	N. Mex	31	15.0	3.3	7.8
Albany	N. Y	31	7.3	0.22	3.6
Buffalo	N. Y	31	10.0	1.8	4.6
New York	N. Y	17	5.0	0.72	2.9
Gastonia	N. C	31	6.6	2.1	4.4
Bismark	N. D	30	7.4	0.64	3.0
Columbus	Ohio	29	7.9	1.9	4.6
Painesville	Ohio	31	6.3	0.76	3.8
Oklahoma City	Okla	31	13.0	3.3	7.0
Ponca City	Okla	31	4.6	1.2	2.8
Portland	Oreg	30	6.3	0.24	2.5
Harrisburg	Pa	29	9.5	0.43	4.6
San Juan	P. R	20	4.5	0.96	2.5
Providence	R. I	28	6.1	0.14	2.7
Columbia	S. C	29	6.2	2.1	3.5
Pierre	S. D	31	7.2	0.43	3.3
Nashville	Tenn	31	8.9	2.2	5.4
Austin	Tex	29	9.7	2.8	5.4
El Paso	Tex	30	11.0	2.8	5.6
Salt Lake City	Utah	30	14.0	0.26	4.3
Barre	Vt	31	7.5	0.16	4.1
Richmond	Va	31	4.6	0.43	3.1
Seattle	Wash	30	3.1	0.38	1.1
Charleston	W. Va	23	5.6	2.1	3.9
Madison	Wis	30	7.9	0.84	4.2
Cheyenne	Wyo	30	18.0	1.4	6.0
Sundance	Wyo	24	18.0	0.62	5.1
Network average					3.70

[a] Weighted average obtained by summing the products of individual sampling times and the corresponding activities, and dividing by the summation of the individual sampling times.

TABLE 2.—GROSS BETA RADIOACTIVITY IN PRECIPITATION, MAY, 1962

Station location		Rainfall (millimeters)	Deposition ($\mu\mu c/m^2$)
City	State		
Adak	Alaska	[a]—	—
Anchorage	Alaska	16.89	12,000
Attu	Alaska	—	—
Cold Bay	Alaska	—	—
Fairbanks	Alaska	—	—
Juneau	Alaska	53.50	34,000
Kodiak	Alaska	—	—
Nome	Alaska	—	—
Point Barrow	Alaska	—	—
St. Paul Island	Alaska	—	—
Phoenix	Ariz	—	—
Little Rock	Ark	31.25	62,000
Berkeley	Calif	—	—
Los Angeles	Calif	—	—
Denver	Colo	4.65	18,000
Hartford	Conn	32.98	69,000
Dover	Del	—	—
Washington	D. C	45.51	60,000
Jacksonville	Fla	15.10	31,000
Miami	Fla	—	—
Atlanta	Ga	12.50	24,000
Agana	Guam	—	—
Honolulu	Hawaii	8.00	3,800
Springfield	Ill	96.25	81,000
Indianapolis	Ind	163.40	340,000
Iowa City	Iowa	176.57	380,000
Topeka	Kans	71.47	390,000
Frankfort	Ky	70.07	150,000
New Orleans	La	25.50	54,000
Augusta	Maine	59.14	73,000
Presque Isle	Maine	29.70	40,000
Baltimore	Md	7.50	6,300
Lawrence	Mass	50.70	73,000
Winchester	Mass	47.73	61,000
Lansing	Mich	45.61	77,000
Minneapolis	Minn	160.36	200,000
Jackson	Miss	—	—
Pascagoula	Miss	—	—
Jefferson City	Mo	49.07	250,000
Helena	Mont	33.50	94,000
Lincoln	Nebr	48.70	75,000
Las Vegas	Nev	—	—
Concord	N. H	—	—
Trenton	N. J	3.92	5,000
Albany	N. Y	29.88	41,000
Buffalo	N. Y	38.37	22,000
New York	N. Y	—	—
Gastonia	N. C	23.45	46,000
Bismarck	N. Dak	138.26	200,000
Columbus	Ohio	78.66	160,000
Painesville	Ohio	43.56	80,000
Oklahoma City	Okla	30.00	<11,000
Ponca City	Okla	51.31	57,000
Portland	Oreg	49.32	31,000
Harrisburg	Penn	31.22	39,000
San Juan	P. R	—	—
Providence	R. I	43.26	65,000
Columbia	S. C	33.97	74,000
Pierre	S. Dak	131.90	150,000
Nashville	Tenn	20.20	23,000
Austin	Tex	17.50	<6,100
El Paso	Tex	—	—
Salt Lake City	Utah	63.40	110,000
Barre	Vt	—	—
Richmond	Va	70.75	92,000
Seattle	Wash	38.72	60,000
Charleston	W. Va	52.23	100,000
Madison	Wis	65.10	240,000
Cheyenne	Wyo	56.70	54,000
Sundance	Wyo	—	—

[a] Dash denotes no sample received.

THE 80TH MERIDIAN (WEST) SAMPLING PROGRAM
April 1962

U.S. Naval Research Laboratory

Radioactivity measurements of surface air samples collected at various sites near the 80th Meridian (West) have been made since 1956. Sampling locations are shown in figure 3. This program is operated by the U. S. Naval Research Laboratory (NRL) with the cooperation of interested agencies of the United States, Canada, Ecuador, Peru, Bolivia, and Chile, which collect the samples and forward them to NRL for analysis. Partial financial support of this program is provided by the Division of Biology and Medicine, U. S. Atomic Energy Commission.

The sampling procedure involves drawing air continuously for a seven-day period, at a rate of approximately 1200 cubic meters per day through a high efficiency filter, 8 inches in diameter, using a positive displacement blower. After the 7-day period, the filter is removed and forwarded to NRL for assay of gross beta activity. A minimum of 2 weeks after collection is allowed for decay of short-lived radionuclides. Data are not extrapolated to time of collection.

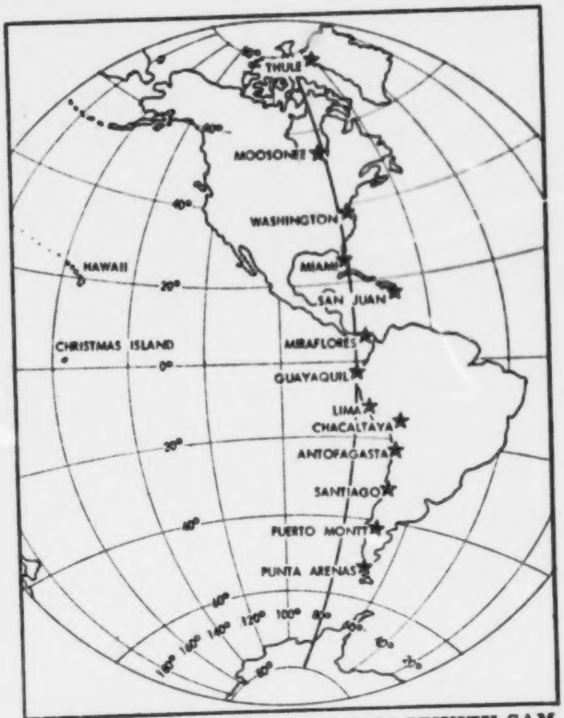

FIGURE 3.—ATMOSPHERIC RADIOACTIVITY SAMPLING STATIONS NEAR THE 80TH MERIDIAN (WEST)

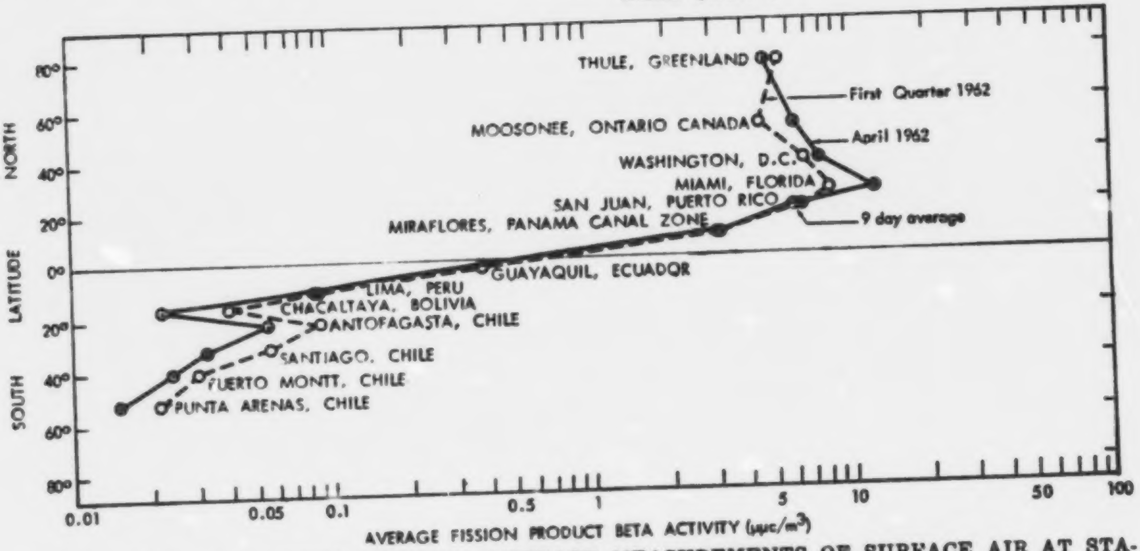

FIGURE 4.—PROFILE OF BETA ACTIVITY, AVERAGE MEASUREMENTS OF SURFACE AIR AT STATIONS NEAR THE 80TH MERIDIAN (WEST), APRIL 1962

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TABLE 3.—FISSION PRODUCT GROSS BETA ACTIVITY IN SURFACE AIR, NRL, APRIL, 1962[a]

[Average concentrations in $\mu\mu c/m^3$][b]

Day	Punta Arenas, Chile	Puerto Montt, Chile	Santiago, Chile	Antofagasta, Chile	Chacaltaya, Bolivia	Lima, Peru	Guayaquil, Ecuador	Miraflores, Panama Canal Zone	San Juan, P. R.	Mauna Loa, Hawaii[c]	Miami, Florida	Washington, D. C.	Moosonee, Ontario, Canada	Thule, Greenland
1														
2	0.014	0.030	0.030	0.068	0.014	0.098	0.158	3.20	6.08	8.91	10.4	11.0	4.77	
3														4.59
4														
5														
6	0.019	0.023	0.028	0.041	0.012	0.128	[d]—	3.50	[illegible].08	3.6[illegible]	10.3	8.[illegible]5	5.44	
7														7.42
8														
9														
10														
11														
12														
13	0.013	0.017	0.038	0.056	0.023	0.071	—	3.58	—	5.44	12.4	4.77	8.42	
14														4.68
15														
16														
17														
18														
19														
20	0.014	0.031	0.032	0.055	0.019	0.083	—	3.58	—	4.86	12.4	7.38	5.18	
21														4.54
22														
23														
24														
25														
26														
27	0.015	—	0.032	0.052	0.036	0.067	—	1.81	—	2.85	16.8	9.68	6.03	
28														2.28
29														
30														
Weighted average	0.015	0.024	0.033	0.053	0.022	0.088	—	3.12	—	4.50	12.8	7.83	6.16	4.82

---

[a] The average concentration determined from a given sample is placed at the center of a rectangle which indicates the length and dates of the sampling period. Station averages for the month were determined by weighting the sample averages according to the number of days in the sampling period or that portion of the sampling period occurring in April 1962.

[b] Note: In the May and June issues, the corresponding units are incorrectly given in $\mu\mu c$/liter; the appropriate units are given above.

[c] Mauna Loa data has been included for comparison which Chacaltaya, Bolivia. Both are high elevation stations (3,400 and 5,200 meters) and about equally distant north and south of the equator.

[d] Dash indicates sample was not received.

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Surface Air Radon, Thoron, and Fission Product Gross Beta Concentrations at Cincinnati, Ohio, April 23–May 18, 1962

Division of Radiological Health, Public Health Service

The determination of natural background radiation in our atmosphere is useful because the exposure levels from natural radiation can be used as a base for comparative evaluations of exposures from artificially produced radionuclides. Natural radioactivity in surface air is attributed to a number of unstable nuclides other than those produced by man. The earth's crust contains trace amounts of uranium and thorium that occur naturally and which decay through a series of their daughter products. These decay products of uranium and thorium are introduced into surface air through their rare gas daughters, radon (radon–222) and thoron (radon–220), which in turn continue to decay through the uranium and thorium series, respectively. The radon and thoron content of air depends on the escape of these rare radioactive gases from the earth. Concentrations depend on prevailing atmospheric conditions such as ambient temperature, humidity, and pressure, and on soil conditions such as moisture, porosity, and temperature.

Most of the natural radioactivity in surface air is due to radon and its daughters. Thoron and its daughters contribute much less because of thoron's short half-life and hence, a lower diffusion rate from the soil.

Radiological Health Research Activities, Research Branch, Division of Radiological Health, Public Health Service, performs a continuous daily sampling program at Cincinnati for radon, thoron, and gross beta fission product concentrations in surface air. The airborne particulates, which include the daughter products of radon and thoron, are collected continuously on a membrane filter surface at a rate of approximately 1.2 cubic meters of air per hour.

Radon–222 concentrations are determined from alpha measurements made immediately after the sampling period (24 to 72 hours) has ceased. Radon–222 (a.m.) concentrations have been corrected for any radon–220 daughter interferences. Radon–222 (p.m.) concentrations are derived from alpha measurements made in the afternoon (3 p.m.) approximately 7 hours after the new sampling period has begun. These values are from the same filters that are counted at 8 a.m. the following day. Radon–222 (p.m.) concentrations are uncorrected for any radon–220 daughter interferences. Radon–220 concentrations are determined from alpha measurements made on the sample used to evaluate the corrected radon–222 (a.m.) concentrations, but are counted 7 hours after the sampling period has ceased. Reported values are corrected to the time of removal of the filter. The gross beta activity of airborne particulates, when measured several days after sample collection, is due principally to artificially-produced fission products.

TABLE 1.—SURFACE AIR RADON (Rn^{222}), THORON (Rn^{220}), AND FISSION PRODUCT GROSS BETA CONCENTRATIONS AT CINCINNATI, OHIO, APRIL 23–MAY 18, 1962

End of sampling period	Rn^{222} 8 a.m. (μμc/m³)	Rn^{222} 3 p.m. (μμc/m³)	Rn^{220} (μμc/m³)	Beta activity (μμc/m³)
April 23	230	80	4.4	10.7
24	670	70	7.6	7.8
25	870	120	11.4	8.6
26	840	110	11.3	11.8
27	820	100	11.6	13.4
30	420	90	8.3	2.8
May 1	70	60	1.5	6.9
2	80	40	0.7	3.6
3	320	60	2.5	7.3
4	600	70	4.8	8.1
7	230	80	5.4	10.2
8	240	150	5.2	6.9
9	140	130	3.1	5.2
10	320	150	5.6	5.6
11	380	120	3.9	8.4
14	590	110	6.1	9.4
15	710	100	7.1	9.0
16	1030	120	9.1	8.4
17	350	170	10.1	7.4
18	1150	190	11.4	8.1
Average	465	101	6.4	8.1
Range of counting errors (2σ):				
Maximum	60	24	1.1	0.22
Minimum	15	11	0.3	0.06

The data are computed by an electronic data processing system which is programmed for thirteen four-week periods per calendar year. The data for the period April 23–May 18, 1962 appear in table 1.

REFERENCE

Setter, L. R. and G. I. Coats "The Determination of Airborne Radioactivity," *American Industrial Hygiene Association Journal, 22:* 64–9 (February 1961).

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SECTION II.—FOOD

Strontium–90 in Raw Foods

Pharmacology Division
Food and Drug Administration

The Food and Drug Administration (FDA) conducts a sampling program to determine the concentrations of certain radionuclides in a variety of different domestic and foreign food items, as well as in animal feeds and other items which may be of importance in the food chain. Most of the domestic products examined for strontium-90 content are raw, unwashed, and unprocessed, and are collected by FDA inspectors, either directly from individual growers or from storage sheds where products are assembled before shipment. Collection records kept by the inspectors include date of collection, date of harvest, date of planting, name of grower or growers, location of farm by county or State, and name and location of marketing cooperative or dealer. When manufactured items are collected, information on the source of the raw materials is recorded.

Although samples are not collected according to a regular schedule or fixed geographical grid, the major growing areas for all of the products are sampled at intervals which usually coincide with harvest dates for the specific crop. Decisions as to what products to sample, sampling intervals, and assigned priorities are reviewed annually and incorporated into a surveillance program which is continually adjusted to cover special fallout situations associated with worldwide nuclear weapons testing. The current program comprises collection of 3500 single samples representing 50 categories of domestic, foreign, and animal foods and analysis for strontium-90. Limited analyses for cesium-137 and iodine-131 are done by gamma spectrometry.

Currently, the method used by the FDA laboratories for the analysis of strontium-90 is a modification of that outlined in the *HASL Manual of Standard Procedures* (*1*), and involves ashing the food at 550 to 600° C, dissolving the ash in hydrochloric acid, precipitating strontium and calcium as oxalates, and separating the strontium from the calcium in concentrated nitric acid. After the radium and lanthanides are scavenged with barium chromate, strontium is determined either by isolation and measurement of the daughter product yttrium-90 after secular equilibrium has been established or by direct measurement as strontium-90 with correction for ingrowth of yttrium-90. The latter method is the procedure of choice because it obviates the 3-week delay period necessary for ingrowth of yttrium-90. It also determines strontium-89, which renders this latter method currently not applicable.

1. Pacific	California, Idaho, Nevada, Oregon, Washington
2. Rocky Mountain	Colorado, Montana, Utah, Wyoming
3. Southwest	Arizona, New Mexico, Oklahoma, Texas
4. North Central	Kansas, Minnesota, Nebraska, North Dakota, South Dakota
5. Great Lakes	Michigan, Wisconsin
6. Mid Central	Arkansas, Illinois, Iowa, Missouri
7. East Central	Indiana, Kentucky, Ohio

[Continued on page 284]

TABLE 1.—GEOGRAPHICAL DISTRIBUTION OF STRONTIUM-90 IN VARIOUS RAW FOODS

Raw food and zone	Pre-test			Post-test		
	No. of samples	Mean (μμc/kg)	Standard deviation of mean	No. of samples	Mean (μμc/kg)	Standard deviation of mean
Cabbage						
West	2	5.3	1.7	4	3.6	1.0
Central	1	6.0	*—	9	5.0	0.9
East	1	23	—	5	13	3
Carrots						
West	10	3.3	0.7	8	3.4	0.7
Central	6	5.0	1.8	5	8.8	3.6
East	7	11	3	4	21	2
Celery						
West	7	3.7	0.9	4	9.3	2.6
Central	10	5.8	1.1	0		
East	1	3.7	—	3	16	11
Lettuce						
West	10	2.1	0.4	14	19	10
Central	10	4.0	1.5	3	4.4	0.8
East	0			1	13	—
Lima Beans (bean)						
West	0			3	3.0	1.9
Central	6	8.2	2.2	2	1.5	0.2
East	5	12	4	3	6.2	1.7
Lima Beans (pod)						
West	0			3	9.3	3.3
Central	6	35	5	2	49	38
East	5	67	25	3	57	7
Onions						
West	7	4.3	1.2	5	7.2	1.6
Central	7	2.3	0.6	1	6.4	—
East	1	0.3	—	1	6.4	—
Potatoes						
West	2	1.2	0.6	15	1.6	0.3
Central	7	2.8	1.4	7	1.6	0.4
East	0			11	1.7	0.2
Root vegetables						
West	2	11	2	7	4.7	1.0
Central	0			6	27	12
East	1	24	—	6	22	6
Snap Beans						
West	11	5.2	1.1	3	3.1	0.5
Central	20	28	6	2	3.9	0.9
East	16	26	6	1	16	—
Soy Beans						
West	1	11	—	2	9.1	1.0
Central	0			9	23	4
East	0			3	96	15
Spinach						
West	11	5.0	0.5	0		
Central	4	48	6	0		
East	0			8	24	3
Tomatoes						
West	8	0.8	0.3	6	0.9	0.4
Central	10	0.5	0.1	1	0.5	—
East	4	1.1	0.1	8	2.6	0.5
Miscellaneous vegetables						
West	0			14	62	15
Central	4	4.2	1.0	1	3.9	—
East	0			15	19	6
Apples						
West	7	0.4	0.1	8	0.4	0.0
Central	4	1.3	0.1	2	1.5	0.2
East	1	2.6	—	15	0.2	0.2
Peaches						
West	7	0.8	0.2	1	2.2	—
Central	4	1.4	0.1	0		
East	5	1.7	0.2	0		
Strawberries						
West	10	2.2	0.6	0		
Central	14	20	2	0		
East	14	11	2	0		
Miscellaneous fruit						
West	1	1.3	—	5	12	2
Central	0			4	4.0	2.8
East	0			2	3.0	1.0
Cheddar cheese						
West	3	51	14	2	125	7
Central	14	48	3	1	21	—
East	5	35	8	0		

* Dash indicates that standard deviation cannot be calculated from data.

TABLE 1.—GEOGRAPHICAL DISTRIBUTION OF STRONTIUM-90 IN VARIOUS RAW FOODS—Continued

Raw food and zone	Pre-test			Post-test		
	No. of samples	Mean (μμc/kg)	Standard deviation of mean	No. of samples	Mean (μμc/kg)	Standard deviation of mean
Egg shell						
West	2	347	146	0		
Central	3	646	335	1	386	—
East	0			0		
Egg substance						
West	3	2.9	0.3	0		
Central	5	2.1	0.5	0		
East	0			2	2.3	1.0
Evaporated milk						
West	4	7.7	4.4	0		
Central	10	21	5	0		
East	2	24	0	0		
Corn grain & Corn meal						
West	4	1.1	0.3	2	0.3	0.0
Central	6	3.5	1.1	2	0.4	0.4
East	7	1.3	0.4	2	0.1	0.1
Rice						
West	6	1.1	0.4	0		
Central	1	1.3	—	8	4.2	1.2
East	0			0		
Rye						
West	2	12	2	0		
Central	2	19	4	0		
East	2	25	0	0		
Wheat						
West	10	12	4	2	2.2	0.3
Central	8	25	6	0		
East	9	28	5	2	12	6
Albacore						
Spain	0			7	0.3	—
Bonita						
Lima, Peru	0			5	0.3	0.2
Haddock (fillet)						
Massachusetts	1	0.1	—	1	0.2	—
Haddock (skin on)						
Massachusetts	1	0.2	—	0		
Georges Bank	0			1	0.2	
Sardines						
Maine, USA	0			3	0.8	0.3
Tuna						
Japan	1	0.1	—	4	0.2	0.1
Portugal	0			1	1.7	—
Almonds						
California, USA	1	0.7	—	0		
Cashews						
Mozambique	0			1	0.0	—
Peanuts						
New Mexico, USA	0			5	14	0.8
Texas, USA	0			1	87	—
Virginia, USA	0			1	6.8	—
Pecans						
New Mexico, USA	0			1	10	—
Oklahoma, USA	0			2	5.4	2.1
Texas, USA	0			1	4.3	—
Georgia, USA	2	12	1	0		
Cocoa Beans						
Ivory Coast	0			1	25	—
Cameroun	0			1	20	—
Angola	1	14	—	0		
Dominican Republic	0			1	18	—
Coffee Beans						
Ivory Coast	1	43	—	0		
British East Africa	1	16	—	0		
Mexico	1	22	—	2	25	0
Tea						
Africa	4	35	10	2	98	55
S. America	4	111	41	0		
Far East	20	328	75	22	357	87

* Dash indicates that standard deviation cannot be calculated from data.

TABLE 2.—STRONTIUM-90 CONTENT OF VARIOUS RAW FOODS

Raw food	Origin			Harvest or collection date	Sr^{90} (μμc/kg)
	Harvest region	State or country	County		
Vegetables					
Beans, lima					
Bean	1	Calif.	Monterey	Oct. 1961	6.7*
Pod				Oct. 1961	9.2*
Bean			Santa Clara	Oct. 1961	0.6*
Pod				Oct. 1961	3.8*
Bean				Oct. 1961	1.6*
Pod				Oct. 1961	15*
Bean	5	Wis.	Calumet	Aug. 1961	4.2
Pod				Aug. 1961	44
Bean			Waushara	Aug. 1961	5.4
Pod				Aug. 1961	46
Bean				Aug. 1961	7.1
Pod				Aug. 1961	11
Bean				Aug. 1961	6.8
Pod				Aug. 1961	39
Bean	6	Ill.	DeKalb	Aug. 1961	6.6
Pod				Aug. 1961	30
Bean				Aug. 1961	19
Pod				Aug. 1961	41
Bean			Ogle	Sept. 1961	1.7
Pod				Sept. 1961	88
Bean				Sept. 1961	1.2
Pod				Sept. 1961	11
Bean	9	N. C.	Henderson	Sept. 1961	2.7
Pod				Sept. 1961	43
Bean	10	Del.	Kent	Aug. 1961	12
Pod				Aug. 1961	46
Bean				Sept. 1961	8
Pod				Sept. 1961	64
Bean	10	N. J.	Burlington	Aug. 1961	5.6
Pod				Aug. 1961	44
Bean			Camden	Aug. 1961	27
Pod				Aug. 1961	160
Bean			Cumberland	Aug. 1961	12
Pod				Aug. 1961	68
Bean	11	Pa.	Bucks	Aug. 1961	3.3
Pod				Aug. 1961	17
Bean			York	Sept. 1961	8.0
Pod				Sept. 1961	64
Beans, snap	1	Calif.	Monterey	Sept. 10, 1960	2.0
			San Benito	Sept. 14, 1960	2.4
			Sonoma	Aug. 15, 1961	2.9
			Santa Cruz	Aug. 15, 1961	2.9
				Sept. 6, 1961	2.9
				Oct. 1, 1961	3.5*
				Oct. 1, 1961	2.3*
				Oct. 4, 1961	3.5*
	1	Wash.	King	Sept. 13, 1961	5.1
	2	Colo.	Weld	Sept. 6, 1960	10
				Aug. 10, 1961	4.2
			Montrose	Aug. 21, 1961	5.0
	2	Utah	Davis	Aug. 3, 1961	14
				Aug. 21, 1961	6.0
	3	Okla.	Adair	June 28, 1961	37
	3	Tex.	Hidalgo	Nov. 16, 1960	3.9
			Cameron	Nov. 21, 1961	4.7*
	5	Mich.	Tuscola	Aug. 16, 1960	8.8
			Delta	Aug. 17, 1960	4.0
			Sanilac	Aug. 24, 1961	6.9
				Aug. 17, 1960	11
			Van Buren	Aug. 16, 1961	2.9
				Aug. 22, 1960	40
	5	Wis.	Calumet	Aug. 31, 1961	2.4
			Waushara	Aug. 31, 1961	27
				Aug. 31, 1961	40
				Aug. 31, 1961	22
	6	Ark.	Benton	Sept. 16, 1960	27
				Sept. 16, 1960	89
				Sept. 16, 1960	7
	6	Ill.	Ogle	Aug. 31, 1961	51
				Sept. 1, 1961	40
				Sept. 1, 1961	11
				Sept. 1, 1961	72
	7	Ohio	Mercer	Aug. 16, 1961	4.1
	8	Tenn.	Medina†	Oct. 31, 1961	3.0*

See p. 284 for footnotes.

TABLE 2.—STRONTIUM-90 CONTENT OF VARIOUS RAW FOODS—Continued

Raw food	Origin			Harvest or collection date	Sr^{90} ($\mu\mu c$/kg)
	Harvest region	State or country	County		
Beans, snap—continued	9	Fla.	Palm Beach	Nov. 15, 1960	3.9
	10	Del.	Sussex	Aug. 24, 1961	36
			Kent	Aug. 30, 1961	36
	10	Md.	Dorchester	Sept. 7, 1960	7.2
				Sept. 7, 1960	14
				Sept. 14, 1960	41
			Worchester	Sept. 19, 1960	98
	10	N. J.	Burlington	Aug. 24, 1961	30*
			Camden	Aug. 24, 1961	16
			Bergen	Oct. 18, 1961	10*
	10	Va.	Shenandoah	Sept. 22, 1960	4.2
	11	N. Y.	Oneida	Sept. 16, 1960	11
			Columbia	Sept. 20, 1960	11
			Wayne	Sept. 22, 1960	46
	11	Pa.	Bucks	Aug. 26, 1961	14
			Cumberland	Aug. 29, 1961	18
			York	Aug. 31, 1961	32
Broccoli					
fresh	1	Calif.	Ventura	Jan. 16, 1962	4.7*
frozen				Jan. 16, 1962	1.6*
fresh			Santa Barbara	Feb. 14, 1962	35*
frozen				Feb. 14, 1962	36*
fresh	10	N. J.	Cumberland	Nov. 8, 1961	14*
frozen				Nov. 8, 1961	10*
fresh	10	Va.	Northampton	Oct. 13, 1961	25*
frozen				Oct. 13, 1961	10*
fresh				Nov. 13, 1961	13*
frozen				Nov. 13, 1961	14*
				Nov. 13, 1961	8.8*
Cabbage	1	Calif.	Ventura	Dec. 15, 1961	4.5*
	1	Idaho	Ada & Canyon	Sept. 7, 1961	3.5
	1	Wash.	Spokane	Oct. 30, 1961	0.7*
			Pierce	Nov. 15, 1961	4.4*
	2	Colo.	Weld	Sept. 6, 1961	7.0
	3	Ariz.	Yuma	Jan. 9, 1962	4.8*
	3	Tex.	Zavala	Nov. 27, 1961	3.1*
			Cameron	Jan. 3, 1962	5.2*
	4	Kans.	Johnson	June 19, 1961	6.0
	5	Mich.	LaPeer	Nov. 3, 1961	2.8*
	5	Wis.	Brown	Nov. 9, 1961	3.8*
			Kenosha	Nov. 9, 1961	3.6*
			Outagamie	Nov. 9, 1961	12*
			Milwaukee	Nov. 10, 1961	4.8*
			Ozaukee	Nov. 10, 1961	3.9*
			Waukesha	Nov. 10, 1961	6.0*
	9	Ga.	Fannin	May 12, 1961	23
	9	N. C.	Pasquotank	Dec. 14, 1961	5.7*
				Dec. 20, 1961	15*
	10	Va.	Floyd	Nov. 7, 1961	26*
			Accomac	Nov. 16, 1961	13*
			Norfolk	Dec. 20, 1961	9.1*
Carrots	1	Calif.	Santa Barbara	Feb. 14, 1961	6.5
			Stanislaus	Feb. 15, 1961	2.0
			San Joaquin	Mar. 1, 1961	2.8
				July 11, 1961	2.5
			Ventura	Mar. 8, 1961	2.4
				Feb. 14, 1962	3.2*
			Orange	May 1, 1961	1.8
			Monterey	July 10, 1961	0.8
			Riverside	Jan. 22, 1962	1.6*
				Jan. 31, 1962	1.3*
	1	Oreg.	Marion	Nov. 1, 1961	3.2*
	1	Wash.	King	Nov. 10, 1960	7.5
			Walla Walla	Nov. 30, 1960	2.8
	2	Colo.	Adams	Sept. 19, 1960	3.6

See p. 284 for footnotes.

TABLE 2.—STRONTIUM-90 CONTENT OF VARIOUS RAW FOODS—Continued

Raw food	Origin			Harvest or collection date	Sr^{90} (μμc/kg)
	Harvest region	State or country	County		
Carrots—(continued)	2	Utah	Davis	Oct. 11, 1961	5.4*
			Utah	Oct. 12, 1961	7.1*
			Sevier	Nov. 10, 1961	4.0*
	3	N. Mex.	Valencia	Nov. 25, 1961	1.5*
	3	Tex.	Kinney	Feb. 15, 1961	3.1
			Zavala	Feb. 15, 1961	6.5
			Hidalgo	Mar. 1, 1961	2.6
				Mar. 29, 1961	1.2
			Dimmit	Jan. 1962	0.5*
	4	Minn.	Anoka	Oct. 15, 1961	22*
	5	Mich.	Antrim	Oct. 15, 1960	13
	5	Wis.	Racine	Oct. 27, 1960	3.8
			Sheboygan	Oct. 14, 1961	4.8*
			Washington	Oct. 14, 1961	9.2*
			Manitowoc	Oct. 17, 1961	7.4*
	10	N. J.	Salem	Oct. 10, 1961	18*
				Oct. 17, 1961	25*
				Oct. 24, 1961	21*
				Oct. 31, 1961	21*
	11	N. Y.	Wayne	Oct. 24, 1960	1.7
			Suffolk	Nov. 14, 1960	9.3
			Ontario	Nov. 30, 1960	4.6
	11	Pa.	Bucks	Jan. 9, 1961	19
	12	Mass.	Hampden	Sept. 27, 1960	18
			Essex	Mar. 7, 1961	4.9
	12	R. I.	Kent	Sept. 21, 1960	21
Cauliflower	1	Wash.	King	Nov. 11, 1961	1.5*
	11	N. Y.	Suffolk	Dec. 5, 1961	6.4*
				Dec. 5, 1961	6.6*
				Dec. 5, 1961	6.0*
				Dec. 5, 1961	6.8*
				Dec. 5, 1961	6.2*
Celery	1	Calif.	Santa Cruz	June 20, 1960	3.3
			San Diego	Jan. 18, 1961	2.1
			Monterey	June 7, 1961	1.7
				June 29, 1961	7.9
				Aug. 23, 1961	1.4
			San Luis Obispo	Dec. 14, 1961	14*
			Santa Barbara	Dec. 14, 1961	2.7*
			Ventura	Jan. 17, 1962	7.4*
			Orange	Jan. 31, 1962	13*
	1	Idaho	Canyon	Sept. 9, 1961	4.5
	2	Colo.	Adams	July 25, 1961	5.3
	5	Mich.	Allegan	July 27, 1961	5.7
			Kent	July 27, 1961	4.3
			Ottawa	July 27, 1961	2.9
				July 27, 1961	14
			Muskegan	July 28, 1961	8.4
				Aug. 2, 1961	7.7
			LaPeer	Aug. 14, 1961	3.5
			Van Buren	Aug. 14, 1961	3.0
	7	Ohio	Huron	Aug. 17, 1961	3.9
				Aug. 29, 1961	4.4
	10	N. J.	Warren	Sept. 7, 1961	3.7
			Burlington	Oct. 1, 1961	1.0*
			Hunterdon	Oct. 10, 1961	10*
	11	Pa.	Bucks	Oct. 4, 1961	37*
Chard	1	Calif.	Butte	Jan. 22, 1962	61*
Collards	9	N. C.	Cumberland	Dec. 21, 1961	88*
	10	Va.	Norfolk	Dec. 18, 1961	29*
Lettuce	1	Calif.	Monterey	May 23, 1961	3.7
				May 24, 1961	3.5
				June 6, 1961	1.5
				June 13, 1961	1.2
				June 22, 1961	1.0

See p. 284 for footnotes.

TABLE 2.—STRONTIUM-90 CONTENT OF VARIOUS RAW FOODS—Continued

Raw food	Origin			Harvest or collection date	Sr^{90} (μμc/kg)
	Harvest region	State or country	County		
Lettuce—continued			Santa Cruz	June 8, 1961	1.5]
				June 22, 1961	1.0]
			Contra Costa	Oct. 9, 1961	2.8*
				Nov. 2, 1961	2.3*
			Imperial	Jan. 11, 1962	6.4*
			Riverside	Jan. 22, 1962	16*
			Sacramento	Jan. 23, 1962	130*
			Santa Clara	Jan. 23, 1962	69*
	1	Wash.	King	Sept. 26, 1961	2.4*
			Pierce	Sept. 28, 1961	3.6*
			Yakima	Nov. 8, 1961	2.4*
	2	Colo.	Alamosa	Aug. 15, 1961	1.7
			Saguache	Aug. 22, 1961	1.7
			Rio Grande	Sept. 13, 1961	4.2
	3	Ariz.	Maricopa	Nov. 15, 1961	9.3*
			Yuma	Dec. 4, 1961	7.9*
				Jan. 8, 1962	13*
	3	N. Mex.	Dona Ana	Oct. 12, 1961	0.7*
				Oct. 14, 1961	0.9*
	3	Tex.	Hidalgo	Mar. 8, 1961	0.5
			Zavala	Nov. 11, 1961	4.1*
				Apr. 25, 1961	1.1
				Apr. 25, 1961	1.7
			Deaf Smith	Sept. 26, 1961	5.1*
			Uvalde	Nov. 15, 1960	4.1*
	5	Mich.	Newargo	Aug. 3, 1961	1.5
			Macomb	Aug. 9, 1961	17
			Ingham	Aug. 15, 1961	3.5
				Aug. 15, 1961	4.3
	7	Ohio	Huron	Aug. 17, 1961	3.7
				Aug. 29, 1961	3.8
			Stark	Aug. 25, 1961	3.2
	10	N. J.	Cumberland	Nov. 7, 1961	13*
Onions	1	Calif.	Stanislaus	June 5, 1961	5.0
			San Joaquin	Aug. 5, 1961	1.6
				Aug. 5, 1961	0.6
			Montrose†	Oct. 2, 1961	13*
	1	Idaho	Payette	Nov. 18, 1960	5.5
	1	Oreg.	Washington	Sept. 1, 1961	2.1
			Malheur	Oct. 31, 1961	3.5*
	2	Colo.	Adams	Aug. 21, 1961	5.6
			Weld	Aug. 28, 1961	9.9
			Delta	Oct. 4, 1961	5.9*
			Prowers	Oct. 12, 1961	6.4*
			Otero	Oct. 14, 1961	6.8*
	3	Tex.	Hidalgo	Mar. 16, 1961	1.8
				Mar. 28, 1961	1.2
				Mar. 30, 1961	1.3
			Zavala	Apr. 25, 1961	1.4
	4	Minn.	Clay	Oct. 1, 1961	6.4*
	11	N. Y.	Genesee	Sept. 14, 1960	0.3
	7	Ohio	Huron	Aug. 17, 1961	5.3
				Sept. 10, 1960	2.1
Parsley	1	Calif.	Monterey	Jan. 6, 1962	130*
				Jan. 10, 1962	53*
			San Benito	Jan. 10, 1962	94*
			San Mateo	Jan. 15, 1962	140*
			Fresno	Jan. 22, 1962	180*
				Jan. 22, 1962	79*
			Orange	Feb. 1, 1962	65*
	10	Md.	Baltimore	Nov. 9, 1961	44*
Parsnips	1	Wash.	Spokane	Nov. 15, 1961	3.9*
Peas					
dry	1	Oreg.	Union	Oct. 31, 1961	7.8*
fresh	3	Tex.	Sullivan	Nov. 20, 1961	3.9*
shelled	4	Minn.	Steele	July 12, 1961	6.6
				July 21, 1961	4.6
			Faribault	July 13, 1961	2.1
			Brown	July 25, 1961	3.3
Peppers	3	Tex.	Hidalgo	Dec. 9, 1961	0.4*
				Dec. 18, 1961	0.7*

See p. 284 for footnotes.

TABLE 2.—STRONTIUM-90 CONTENT OF VARIOUS RAW FOODS—Continued

Raw food	Origin			Harvest or collection date	Sr^{90} ($\mu\mu c$/kg)
	Harvest region	State or country	County		
Peppers—continued	10	Md.	Baltimore	Nov. 8, 1961	3.5*
			Montgomery	Nov. 8, 1961	0.0*
	10	N. J.	Cumberland	Nov. 7, 1961	2.4*
Potatoes	1	Idaho	Madison	Oct. 1, 1961	4.5*
			Bonneville	Oct. 10, 1961	2.1*
			Jerome	Oct. 11, 1961	1.2*
			Twin Falls	Oct. 11, 1961	0.8*
			Canyon	Dec. 18, 1961	2.0*
			Payette	Dec. 21, 1961	1.5*
	1	Oreg.	Baker	Sept. 27–Oct. 21, 1961	0.9*
	1	Wash.	Yakima	July 10, 1961	0.7
			Grant	Oct. 10, 1961	1.0*
			Franklin	Nov. 29, 1961	1.2*
	2	Colo.	Weld	Apr. 8-28, 1961	1.6
				Sept. 15–Oct. 3, 1961	1.9*
			Rio Grande	Oct. 1961	1.9*
			Alamosa	Oct. 1, 1961	1.3*
			Morgan	Oct. 1, 1961	0.4*
			Montrose	Nov. 14, 1961	0.8*
			Grand	Nov. 16, 1961	2.5*
	3	Tex.	Crosby	Aug. 3, 1960	0.4
				June 26, 1961	2.7
				July 20, 1961	0.7
			Deaf Smith	June 25, 1961	0.9
			Hale	Nov. 1, 1961	2.0*
			Parmer	Nov. 5, 1961	0.4*
			Castro	Nov. 18, 1961	1.4
			Gaines	Nov. 21, 1961	2.1*
	4	Minn.	Anoka	Sept. 15, 1961	1.0*
			Sherburne	1961	3.1
	5	Mich.	Bay	Sept. 1, 1961	1.1
	5	Wis.	Barron	Oct. 1, 1961	3.5*
			Walworth	Nov. 1, 1961	0.8*
	6	Ill.	Granite†	July 11, 1960	11
	10	N. J.	Monmouth	Oct. 7-14, 1961	2.0*
			Cumberland	Nov. 8, 1961	3.3*
			Middlesex	Nov. 16, 1961	1.6*
	11	N. Y.	Suffolk	Sept. 10, 1961	1.4
				Sept. 10, 1961	1.3
				Sept. 10, 1961	1.7
				Sept. 10, 1961	1.2
				Sept. 10, 1961	1.8
				Sept. 10, 1961	1.9
				Sept. 10, 1961	1.6
				Sept. 10, 1961	0.4
Potatoes, sweet					
peels	1	Calif.	Orange	Dec. 1, 1961	4.3*
				Dec. 1, 1961	4.1*
whole	3	Tex.	Camp	Oct. 1, 1961	16*
			Van Zandt	Oct. 1, 1961	20*
			Rains	Oct. 10, 1961	11*
			Wood	Oct. 10, 1961	20*
peels				Oct. 10, 1961	85*
whole	9	N. C.	Union	Oct. 1, 1960	24
			Columbus	Oct. 1, 1961	14*
			Martin	Oct. 1, 1961	24*
whole	10	Va.	Accomac	Oct. 25, 1961	23*
peels				Oct. 25, 1961	51*
whole	10	N. J.	Atlantic	Nov. 21, 1961	14*
Rutabagas	1	Wash.	Yakima	Oct. 15, 1961	2.7*
Soybeans	2	Colo.	Larimer	Sept. 28, 1960	11.0
				Oct. 26, 1961	7.1*
			Prowers	Oct. 26, 1961	11*
	3	Tex.	Hale	Nov. 1-11, 1961	12*
				Nov. 1961	10*
				Dec. 8, 1961	18*
	4	Minn.	Sibley	Oct. 9-14, 1961	17*
	5	Mich.	Monroe	Oct. 23, 1961	35*
	6	Ill.	Madison	Oct. 5, 1960	31
			La Salle	Nov. 1961	13*

See p. 284 for footnotes.

TABLE 2.—STRONTIUM-90 CONTENT OF VARIOUS RAW FOODS—Continued

Raw food	Origin			Harvest or collection date	Sr^{90} (μμc/kg)
	Harvest region	State or country	County		
Soybeans—continued	7	Ind.	Fulton	Sept. 15-30, 1961	34.5*
	7	Ohio	Clinton	Oct. 16, 1961	32*
	9	N. C.	Johnston	Dec. 1, 1961	110*
	10	Md.	Wicomico	Nov. 21, 1961	65*
	10	Va.	Accomac	Nov. 1961	11*
Spinach	1	Calif.	San Joaquin	Mar. 14, 1961	2.8
			Orange	Mar. 15, 1961	3.8
			Yolo	Mar. 21, 1961	4.9
				Mar. 28, 1961	7.1
			Monterey	Mar. 28, 1961	6.9
				Apr. 5, 1961	5.0
				Apr. 5, 1961	6.4
			Stanislaus	Apr. 11, 1961	4.6
			Ventura	Apr. 26, 1961	7.4
				May 4, 1961	3.4
				May 11, 1961	2.7
	6	Ark.	Mississippi	Mar. 23, 1961	45
			Van Buren	Apr. 12, 1961	43
	6	Mo.	Crawford	Apr. 12, 1961	37
				May 10, 1961	43
	10	Md.	Baltimore	Nov. 14, 1961	7.0*
			Kent	Nov. 15, 1961	34*
	10	N. J.	Salem	Oct. 10, 1961	22*
			Cumberland	Oct. 17, 1961	21*
				Oct. 24, 1961	29*
				Oct. 31, 1961	28*
				Nov. 8, 1961	31*
	10	Va.	Accomac	Nov. 14, 1961	20*
Squash	1	Wash.	Spokane	Sept. 20, 1961	6.6*
	3	Tex.	Hidalgo	Dec. 7, 1961	2.7*
	4	Minn.	Anoka	Sept. 15, 1961	12*
Tomatoes	1	Calif.	San Benito	Sept. 14, 1960	0.2
			Yolo	Sept. 15, 1960	0.2
			Ventura	Dec. 13, 1961	0.9*
			Sutter	Dec. 18, 1961	1.4*
			San Diego	Feb. 15, 1962	0.2*
	1	Wash.	Yakima	Sept. 13, 1961	0.1
			Walla Walla	Sept. 20, 1961	0.1*
	2	Colo.	Davis†	Aug. 23, 1961	1.1
			Mesa	Aug. 28, 1961	0.8
			Delta	Sept. 12, 1961	0.8
			Morgan	Sept. 22, 1961	2.5*
	2	Utah	Weber	Sept. 13, 1960	0.5
				Aug. 23, 1961	2.9
	3	N. Mex.	Otero	Oct. 16, 1961	0.5*
	3	Tex.	Hidalgo	June 8, 1961	0.2
				June 22, 1961	0.4
				June 26, 1961	0.5
				June 27, 1961	0.4
			Cameron	June 20, 1961	0.1
			Floyd	Oct. 8, 1961	0.5*
	5	Mich.	Lenawee	Aug. 24, 1960	0.3
	7	Ind.	Tipton	Sept. 13, 1960	0.8
			Wells	Sept. 22, 1960	1.3
				Sept. 23, 1960	0.6
	7	Ohio	Williams	Sept. 2, 1960	0.5
	9	Fla.	Hendry	Jan. 10-17, 1961	1.9
	10	Md.	Wicomico	Sept. 25, 1961	1.0*
			Dorchester	Sept. 26, 1961	4.0*
			Baltimore	Sept. 28, 1961	1.5*
	10	Va.	Scott	Sept. 28, 1961	3.3*
	10	W. Va.	Morgan	Sept. 27, 1961	3.7*
				Sept. 27, 1961	5.1*
	11	N. Y.	Niagara	Sept. 19-20, 1960	1.2
			Ontario	Sept. 27, 1961	2.1*
	11	Pa.	Montgomery	Nov. 9, 1961	1.2*

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TABLE 2.—STRONTIUM-90 CONTENT OF VARIOUS RAW FOODS—Continued

Raw food	Origin			Harvest or collection date	Sr^{90} (μμc/kg)
	Harvest region	State or country	County		
Tomatoes—continued	12	Mass.	Bristol	Sept. 1960	1.2
			Middlesex	Sept. 7-8, 1960	1.2
Turnips	1	Calif.	San Diego	Feb. 15, 1962	2.8*
	1	Wash.	Multnomah†	Feb. 8, 1961	13
			Spokane	Nov. 7, 1961	10*
			Pierce	Nov. 15, 1961	8.8*
	3	Ariz.	Maricopa	Oct. 31, 1961	5.4*
	4	Minn.	Anoka	Oct. 30, 1961	12*
	11	Pa.	Montgomery	Nov. 9, 1961	6.5*
Fruit					
Apples	1	Calif.	Santa Clara	Sept. 10, 1960	0.3
				Aug. 15, 1961	0.2
				Aug. 15, 1961	0.2
				Aug. 20, 1961	0.3
	1	Idaho	Payette	Nov. 4, 1961	0.3*
			Canyon	Dec. 14, 1961	0.4*
			Washington	Dec. 15, 1961	0.4*
	1	Oreg.	Hood River	Oct. 15, 1961	0.5*
	1	Wash.	Yakima	Sept. 25, 1961	0.2*
			Klickitat	Oct. 15, 1961	0.0*
			Columbia	Nov. 30, 1961	0.4*
	2	Colo.	Fremont	Sept. 10, 1961	0.3
			Mesa	Nov. 16, 1961	0.4*
	2	Utah	Utah	Aug. 29, 1961	1.0
	3	N. Mex.	Lincoln	Aug. 9, 1961	0.6
	4	Minn.	Houston	Sept. 1, 1961	1.4
				Sept. 1, 1961	1.4
	5	Mich.	Macomb	Aug. 11, 1961	1.3
	5	Wis.	Jefferson	Oct. 1, 1961	1.2*
	6	Ill.	Calhoun	Oct. 1, 1961	1.7*
	10	Md.	Wicomico	Oct. 3, 1961	0.4*
			Somerset	Oct. 4, 1961	0.9*
			Washington	Oct. 10, 1961	0.0*
	10	N. J.	Burlington	Oct. 1, 1961	1.8*
			Warren	Oct. 9, 1961	1.3*
			Gloucester	Nov. 1, 1961	1.8*
	10	W. Va.	Hampshire	Oct. 7, 1960	2.6
				Oct. 9, 1961	2.0*
			Jefferson	Oct. 16, 1961	0.6*
	11	N. Y.	Orange	Oct. 5, 1961	1.9*
				Oct. 7, 1961	1.5*
			Columbia	Oct. 9, 1961	1.3*
	11	Pa.	Bucks	Oct. 4, 1961	0.8*
			Lehigh	Oct. 5, 1961	1.0*
			Berks	Oct. 29, 1961	1.8*
Cranberries	1	Oreg.	Coos	Nov. 22, 1961	12*
			Curry	Nov. 22, 1961	17*
	1	Wash.	Grays Harbor	Oct. 13, 1961	13*
			Pacific	Nov. 30, 1961	14*
Peaches	1	Calif.	Kern	June 7, 1961	0.4
			Stanislaus	Aug. 7, 1961	0.4
			San Joaquin	Aug. 22, 1961	0.4
			Merced	Sept. 14, 1961	0.5
	2	Colo.	Mesa	Aug. 20, 1961	1.4
				Aug. 26, 1961	1.
	2	Utah	Weber	Sept. 9, 1960	1.2
			Box Elder	Sept. 21, 1961	2.2*
	5	Mich.	Mason	Aug. 30, 1960	1.4
			Wayne	Sept. 8, 1960	1.2
			Oceana	Sept. 12, 1960	1.6
			Van Buren	Sept. 21, 1960	1.2
	10	Md.	Washington	Sept. 6, 1961	1.4
	10	Va.	Rappahannock	Aug. 20, 1960	1.6
			Accomac	Sept. 1, 1961	2.1
			Frederick	Sept. 1, 1961	2.4

See p. 284 for footnotes.

TABLE 2.—STRONTIUM-90 CONTENT OF VARIOUS RAW FOODS—Continued

Raw food	Origin			Harvest or collection date	Sr^{90} (μμc/kg)
	Harvest region	State or country	County		
Peaches—continued	11	N. Y.	Niagara	Sept. 1, 1960	1.1
Raisins, Muscat	1	Calif.	Fresno	Sept. 8, 1960	1.3
Strawberries	1	Calif.	Santa Cruz	Nov. 1, 1960	1.1
				May 10, 1961	1.1
				Sept. 28, 1961	0.9[*]
			Orange	Apr. 27, 1961	1.5
				Apr. 28, 1961	1.8
			Ventura	Apr. 27, 1961	1.1
			Fresno	May 3, 1961	2.8
			San Luis Obispo	May 3, 1961	0.9
	1	Wash.	Pierce	June 27, 1961	6.9
			Scagit	June 30, 1961	3.3
	4	Kans.	Miami	June 7, 1961	11
	5	Mich.	Berrien	July 13, 1961	18
			Houghton	July 17, 1961	29
				July 20, 1961	18
				July 20, 1961	27
	5	Wis.	Door	July 10, 1961	11
				July 10, 1961	2.5
	6	Ark.	Johnson	May 15, 1961	35
	7	Ind.	Knox	June 13, 1961	19
	8	La.	Livingston	Mar. 20, 1961	12
			Tangipahoa	Apr. 12, 1961	21
	8	Tenn.	Madison	May 10, 1961	22
			Rhea	June 7, 1961	34
			Sumner	June 8, 1961	24
	9	Fla.	Dade	Jan. 12, 1961	4.1
			Palm Beach	Jan. 18, 1961	14
			Manatee	Apr. 4, 1961	5.2
			Hillsborough	Apr. 3, 1961	3.6
	9	N. C.	Duplin	Apr. 1, 1961	18
	10	Del.	Sussex	May 22, 1961	17
	10	N. J.	Cumberland	June 5, 1961	10
				June 5, 1961	12
	10	Va.	Princess Anne	May 18, 1961	24
			Accomac	May 19, 1961	16
	11	N. Y.	Erie	June 16, 1961	14
			Orleans	June 26, 1961	11
	12	Mass.	Barnstable	June 15, 1961	21
			Middlesex	June 27, 1961	13
Dairy products Cheese, cheddar	1	Idaho		Oct. 1, 1961	120[*]
				Nov. 1, 1961	120[*]
	1	Oreg.		Mar. 9, 1961	62
				Oct. 1, 1961	67[*]
	2	Utah		Aug. 28, 1960	23
	4	Minn.		Aug. 31, 1960	51
				Dec. 30, 1961	21[*]
	6	Ill.		Feb. 11, 1960	44
				Nov. 8, 1960	35
				Jan. 21, 1961	54
				Feb. 21, 1961	42
	6	Mo.		Sept. 1, 1960	38
				Oct. 20, 1960	48
				Nov. 1, 1960	38
				Feb. 27, 1961	80
	11	N. Y.		Sept. 13, 1960	43
				Oct. 26, 1960	12
				Nov. 29, 1960	19
				Jan. 31, 1961	48
				Feb. 23, 1961	53
	7	Ohio		Oct. 3, 1960	32
				Oct. 31, 1960	62
				Nov. 30, 1960	54
				Jan. 4, 1961	42
				Feb. 28, 1961	57
Eggs substance	1	Calif.	Sonoma	Feb. 1, 1961	3.0

See p. 284 for footnotes

TABLE 2.—STRONTIUM-90 CONTENT OF VARIOUS RAW FOODS—Continued

Raw food	Origin			Harvest or collection date	Sr^{90} (μμc/kg)
	Harvest region	State or country	County		
Eggs—continued					
shell					200
substance				June 13, 1961	3.5
shell					490
substance			Stanislaus	1960	2.3
substance	4	Minn.	Wright	Dec. 12, 1960	1.6
shell					130
shell				Dec. 19, 1961	390*
substance	5	Mich.	Kalamazoo	Oct. 24, 1960	0.7
substance				Jan. 26, 1961	2.0
substance				Mar. 15, 1961	3.8
shell					1200
substance	6	Mo.	Franklin	Mar. 29, 1961	2.4
shell					550
substance	10	N. J	Cumberland	Oct. 6, 1961	3.2*
substance	11	Pa.	Bucks	Oct. 6, 1961	1.3*
Milk					
Evaporated	1	Calif.		Nov. 7, 1960	2.4
				Dec. 12, 1960	4.2
				Dec. 15, 1960	3.3
		Wash.		Dec. 9, 1961	21
	4	Minn.		Feb. 1, 1960	13
	5	Wis.		Dec. 1, 1960	8.6
				Dec. 14, 1960	12
				Feb. 20, 1961	8.9
	6	Ark.		Dec. 5, 1960	64
	6	Ill.		Dec. 2, 1960	18
				Dec. 12, 1960	12
	7	Ky.		Dec. 6, 1960	22
	7	Ohio		Nov. 1, 1960	16
	8	Tenn.		Dec. 1, 1960	32
	9	N. C.		Dec. 6, 1960	24
	11	Pa.		Sept. 15, 1960	24
Grain					
Corn					
grain	2	Colo.	Weld	Nov. 1, 1961	0.2*
			Morgan	Oct. 20, 1961	0.3*
meal	3	N. Mex.	Sandoval	Sept. 20, 1960	1.7
grain				Sept. 20, 1960	1.5
meal			Curry	Sept. 1, 1961	0.8
				Sept. 1, 1961	0.3
grain	3	Tex.	Fannin	Nov. [illegible], 1961	0.2*
grain	4	Minn.	Carver	Oct. 20, 1960	2.0
meal				Oct. 20, 1960	3.5
grain	4	S. D.		1961	2.4
grain	5	Wis.	Milwaukee	1960	2.5
meal				1960	2.0
grain			Fond du Lac	Oct. 16, 1961	0.5*
grain	7	Ind.	Cass	June 15, 1960	8.8
grain	9	Ga.	Grady	Aug. 1, 1960	2.0
meal				Aug. 1, 1960	1.8
grain			Laurens	Nov. 9, 1960	2.4
meal				Nov. 9, 1960	1.9
grain	9	N. C.	Hertford & Northampton	Jan. 19, 1962	0.3*
meal				Jan. 19, 1962	0.0*
grain	10	Md.	Carroll	Sept. 1, 1961	0.0
meal				Sept. 1, 1961	1.0
grain	11	Va.	Louisa	Sept. 1, 1961	0.0
meal					
Rice					
rough	1	Calif.	Butte	Oct. 8–11, 1960	0.2
milled				Oct. 8–11, 1960	2.8
rough			Fresno	Oct. 15, 1960	1.1
milled				Oct. 15, 1960	0.1
rough			Merced	Oct. 10, 1960	1.9
milled				Oct. 10, 1960	0.3

See p. 284 for footnotes.

TABLE 2.—STRONTIUM-90 CONTENT OF VARIOUS RAW FOODS—Continued

Raw food	Origin			Harvest or collection date	Sr^{90} (μμc/kg)
	Harvest region	State or country	County		
Rice—continued					
rough	3	Tex.	Brazoria	Oct. 1-16, 1961	6.5*
milled				Oct. 1-16, 1961	1.0*
rough			Jackson	Oct. 1, 1961	7.4*
milled				Oct. 1, 1961	1.5*
rough			Jefferson	Oct. 1, 1961	8.3*
milled				Oct. 1, 1961	0.5*
rough			Harris	Oct. 1, 1961	6.9*
milled				Oct. 1, 1961	1.7*
rough	6	Ark.	Jackson	Oct. 1, 1960	1.3
Rye	2	Colo.	Bent	July 1, 1960	14
	2	Wyo.	Platte	Aug. 1961	9.4
	5	Mich.	Bay	Aug. 1961	23
	7	Ohio	Wood	July 5, 1961	15
Flour	10	Va.	Louisa	July 1, 1961	25
Wheat	1	Idaho	Elmore	Aug. 9, 1960	5.7
			Bonneville	July 5, 1961	5.1
				Sept. 5, 1961	5.4
	2	Colo.	Rogan†	July 1, 1961	41
			Adams	July 10, 1961	16
			Phillips	July 18, 1961	16
			Pueblo	Aug. 1, 1961	18
	2	Mont.	Gallatin	Mar. 29, 1961	7.2
			Toole	Dec. 20, 1961	2.5*
				Dec. 20, 1961	1.9*
	6	Utah	Cache	July 15– Aug. 15, 1960	3.4
	3	N. Mex.	Curry	June 1, 1961	6
	3	Tex.	Denton	May 1, 1961	16
			Callahan	June 15, 1961	6.4
	4	Minn.	Olmstead	July 1, 1960	55
	5	Mich.	Monroe	July 28, 1960	19
				Aug. 1, 1961	18
	6	Mo.	Texas	July 1, 1960	80
	7	Ohio	Mahoning	Aug. 1, 1961	22
			Paulding	Aug. 1, 1961	11
	9	Ga.	Bartow	June 15, 1961	3
	9	N. C.	Tredell†	July 1, 1960	45
	9	S. C.	York	June 15- July 1, 1960	29
			Anderson	June 15- July 15, 1960	27
	10	Md.	Frederick	July 1960	29
			Carroll	Oct. 1960	28
			Washington	Jan. 3, 1962	18*
	10	W. Va.	Greenbrier	Oct. 1960	58
	10	Va.	Hanover	Feb. 5, 1962	5.9*
	11	N. Y.	Onondaga	1960	24
			Genesee	Aug. 1960	11
Beverage Bases					
Cocoa beans		Africa (Angola)		Feb. 24, 1961	14
		(Camerouns)		Jan. 22, 1962	20*
		(Ivory Coast)		Dec. 18, 1961	25*
		Dominican Republic		Dec. 8, 1961	18*
Coffee beans		Africa (Ivory Coast)		Feb. 14, 1961	43
		(BEA)		Feb. 14, 1961	15
		Mexico		Jan. 4, 1961	22
				Dec. 18, 1961	25*
				Dec. 20, 1961	25*

See p. 284 for footnotes.

TABLE 2.—STRONTIUM-90 CONTENT OF VARIOUS RAW FOODS—Continued

Raw food	Origin			Harvest or collection date	Sr^{90} ($\mu\mu c$/kg)
	Harvest region	State or country	County		
Tea		Argentina		Nov. 3, 1960	37
				May 24, 1961	47
		Belgian Congo		Feb. 26, 1962	15**
		British East Africa		Feb. 26, 1962	43**
				Mar. 24, 1962	56
		Brazil		Dec. 14, 1960	160
				May 24, 1961	200
		Ceylon		Nov. 1, 1960	315
				Jan. 22, 1961	256
				Jan. 22, 1961	267
				Jan. 22, 1961	376
				Jan. 20, 1961	110
				Nov. 29, 1961	142**
				Nov. 29, 1961	244**
				Dec. [illegible], 1961	[illegible]**
				Dec. 21, 1961	182**
				Dec. 21, 1961	97**
				Dec. 15, 1961	219**
				Jan. 11, 1962	279**
				Jan. 18, 1962	253**
				Jan. 18, 1962	167**
				Jan. 23, 1962	175**
				Jan. 24, 1962	154**
				Jan. 26, 1962	169**
				Feb. 6, 1962	193**
		Formosa		Oct. 11, 1960	450
				June 16, 1961	1120
		India		Mar. 27, 1960	310
				Oct. 11, 1960	115
				Oct. 27, 1960	240
				Jan. 30, 1961	780
				Mar. 30, 1961	1163
				Jan. 25, 1962	89
				Feb. 5, 1962	193**
				Feb. 5, 1962	1629**
				Feb. 5, 1962	1092**
				Feb. 6, 1962	1133**
				Feb. 14, 1962	275**
				Feb. 14, 1962	293**
		Indonesia		Feb. 8, 1962	68**
				Feb. 8, 1962	29**
		Japan		Oct. 18, 1960	180
				Jan. 30, 1961	490
		Java		Nov. 1, 1960	36
				Jan. 30, 1961	71
				June 16, 1961	83
		Kenya		Oct. 17, 1960	19
				Mar. 30, 1961	40
		Mozambique		May 24, 1961	15
		Pakistan		Jan. 9, 1962	662**
		Sumatra		Nov. 1, 1960	40
				Feb. 13, 1961	57
Fish					
Albacore		Spain		Dec. 7, 1961	0.3*
Bonita		Lima, Peru		Dec. 4, 1961	0.2*
				Dec. 4, 1961	0.4*
				Dec. 8, 1961	0.1*
				Dec. 8, 1961	0.0*
				Dec. 11, 1961	1.0*
Haddock, fillet (skin on)	12	Mass.		Oct. 7, 1961	0.1*
				Aug. 23, 1961	0.2
		Georges Bank		Oct. 26, 1961	0.2*
				Nov. 15, 1961	0.2*
Sardines	12	Maine		Nov. 16, 1960	0.3*
				Nov. 7, 1961	0.7*
				Nov. 8, 1961	1.3*
Tuna		Angola		Dec. 12, 1961	0.0*
		Japan		Oct. 20, 1960	0.1
				Nov. 20, 1961	0.4*
				Dec. 11, 1961	0.3*
				Dec. 11, 1961	0.1*
				Dec. 23, 1961	0.1*

See p. 284 for footnotes.

TABLE 2.—STRONTIUM-90 CONTENT OF VARIOUS RAW FOODS—Continued

Raw food	Origin			Harvest or collection date	Sr^{90} (μμc/kg)
	Harvest region	State or country	County		
Tuna—continued		Portugal		Dec. 15, 1961	1.7*
Nuts					
Almonds	1	Calif.		Dec. 14, 1960	0.7
Cashew		Africa (Mozambique)		Jan. 26, 1962	0.0*
Peanuts	3	N. Mex.		Nov. 17, 1961 Nov. 17, 1961 Nov. 17, 1961 Jan. 3, 1962 Jan. 3, 1962	14* 16* 11* 14* 15*
	3	Tex.		Dec. 8, 1961	87*
	10	Va.		Feb. 13, 1962	6.8*
Pecans	3	N. Mex.		Nov. 1, 1961	19*
	3	Okla.		Nov. 14, 1961 Nov. 14, 1961	7.4* 3.3*
	3	Tex.		Dec. 14, 1961	4.3*
	9	Ga.		Nov. 15, 1960 Dec. 9, 1960	13 11

* Products harvested after September 15, 1961.
† City
** The date of collection of import is approximately 3 to 4 months after harvest date.

8. South Central	Alabama, Louisiana, Mississippi, Tennessee
9. South Eastern	Florida, Georgia, North Carolina, South Carolina
10. Mid Atlantic	Delaware, Maryland, New Jersey, Virginia, West Virginia
11. Mid Eastern	New York, Pennsylvania
12. New England	Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont

Figure 1 illustrates the harvest zones listed in table 1, and harvest regions indicated in table 2. The number of samples collected, the average values, and the standard deviations for the regional distribution of strontium–90 in various foods are presented in table 1. Pre-testing and post-testing values for each harvest zone are indicated.

Comments

From the data in table 1, several limited observations can be made, since the numbers of samples are small. The 1960–1961 east-west relationship may be noticed in some food items. Pre-test average strontium–90 concentrations in snap beans, carrots, strawberries, and wheat from the east zone are higher than those from the west zone. Post-test average strontium–90 concentrations in cabbage and soybeans from the east zone are higher than in the same items from the west zone. Post-test average strontium–90 concentrations are higher than pre-test average strontium–90 concentrations for lettuce and celery in the west zone. In consideration of the contribution of any of the above foods to the strontium–90 content of the total diet, and assuming an "action point" for strontium–90 of 200 μμc/day, none of the values reported so far would form the basis for corrective action.

Previous coverage in *Radiological Health Data:*

Period	*Issue*
1958 and 1959	May 1960
1958, 1959, and 1960	January 1961
1960	August 1961
1959 and 1960	September 1961
1958, 1959, 1960, and 1961	December 1961
1960 and 1961	April 1962

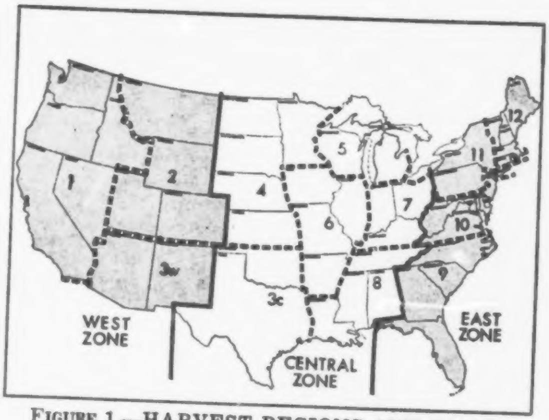

FIGURE 1.—HARVEST REGIONS AND ZONES

SECTION III.—MILK

Radionuclide Analyses of Pasteurized Milk

PASTEURIZED MILK MONITORING NETWORK
March 1962

Division of Radiological Health, and
Division of Environmental Engineering & Food Protection,
Public Health Service

Milk monitoring has been conducted by the Public Health Service since early 1957, when the first program was established to develop suitable sampling methods and radiochemical analytical procedures. Raw milk was initially selected for investigation. During this program, it became evident that a broader sampling program was necessary—one more directly related to the milk consumed by the population. The result was the initiation, in the first quarter of 1960, of a pasteurized milk sampling program designed to provide data representative of the milk consumed in selected municipalities. Both programs were reported concurrently until June 1961 to permit comparison of the differences between the earlier, limited, milkshed sampling results and those of the new program.

The June 1961 raw milk sampling results, reported in the November 1961 *Radiological Health Data (RHD)*, represent the last regular publication of such data. A summary discussion of the raw milk sampling program in the December 1961 *RHD* presented the gross relationship between fallout and the occurrence of fission products in milk determined from this study.

During March 1962 the surveillance of pasteurized milk was conducted at 61 stations (shown in figure 1) with the cooperation of State and local milk sanitation agencies who ship samples to the PHS Southeastern and Southwestern Radiological Health Laboratories for analysis.[1] The former analyzes samples from the 30 States generally east of the Mississippi River, and the latter analyzes samples from the western States. Publication in *RHD* follows about four months after sample collection because of time required for shipment, processing, decay-product buildup, data compilation, and publication procedures.

The current program emphasizes (1) measurement of the concentrations of radioactivity in samples of pasteurized milk consumed by the public in various regions of the country,

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[1] Northeastern Radiological Health Laboratory began processing of milk samples with those collected after May 7, 1962, for the states of Maine, Vermont, New Hampshire, Massachusetts, Rhode Island, and Connecticut; after May 21, from New York, New Jersey, Pennsylvania, and Delaware; and after June 11 from Illinois, Indiana, Wisconsin, Michigan, and Ohio.

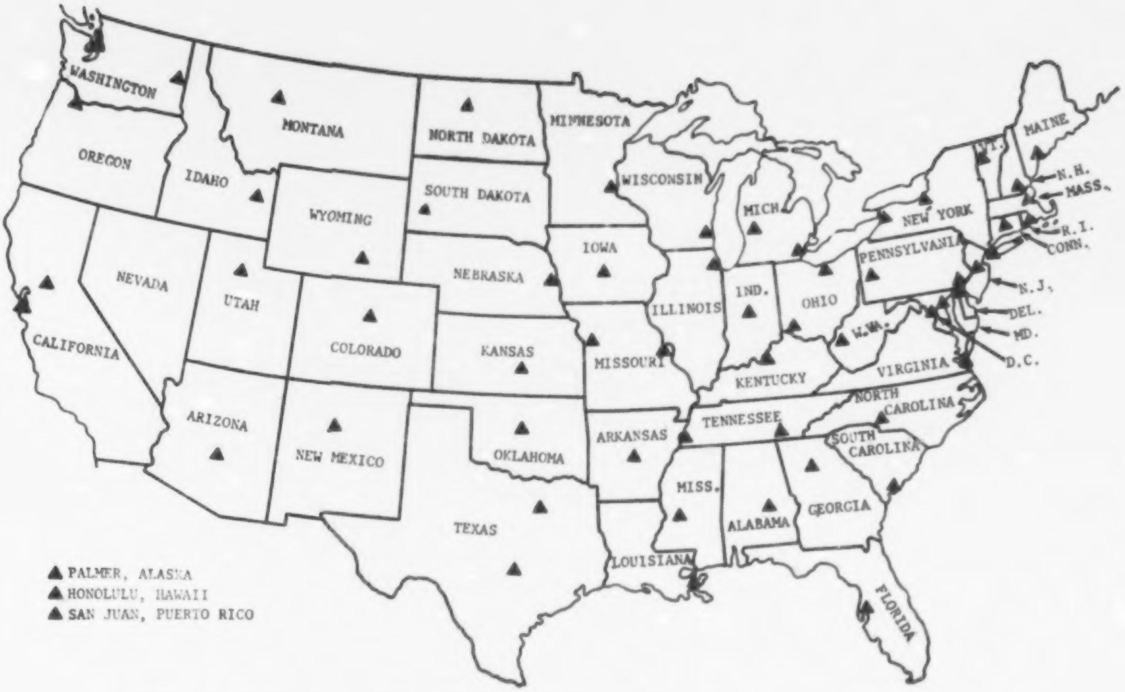

FIGURE 1.—PASTEURIZED MILK AREA SAMPLING STATIONS, MARCH 1962

and (2) provision of at least one sampling point within virtually all states and additional points when indicated by widely varying conditions of the milk supply or the need to cover large population groups. Each sample is composited in proportion to the volume of milk sold by those plants supplying not less than 90 percent of a city's milk supply. Prior to September 15, 1961, this composite sample was taken from one day's sales per month and was as representative of a community's total supply as could be achieved under practical conditions. Since September 15, the sampling schedule has been accelerated.

During March 1962, sampling on a weekly basis was performed at most stations. All surveillance data are subject to continuing review and evaluation to observe unusual patterns or concentrations which may require immediate attention and adjustment in the pasteurized milk sampling program operation. Further atmospheric nuclear testing may require an immediate re-evaluation and readjustment of the sampling frequency and analytical schedule for this program.

Iodine-131, cesium-137, and barium-140 are determined by gamma scintillation spectroscopy, while strontium-89 and strontium-90 are determined following radiochemical separation. The minimum detectable concentrations in units of μμc/liter are: Sr^{89}, 5; Sr^{90}, 1; I^{131}, 10; Cs^{137}, 5; and Ba^{140}, 10.

In the previous three issues, *RHD* published graphical presentations of the average monthly concentrations of strontium-90 in pasteurized milk from 20 selected cities from the monitoring network. An additional 16 cities are similarly represented in figure 2.

Figures 3 and 4 portray the strontium-90 and strontium-89 concentrations during March 1962 by means of iso-concentration contours. Still evident, as during December, January, and February, is the strontium-89 pattern of nondetectable concentrations at most stations in the Northeast and North Central sections of the United States, low concentrations in the West, and higher concentrations in the South. The strontium-90 concentrations also generally follow this pattern. This pattern is apparently due to the practice in the North of feeding cat-

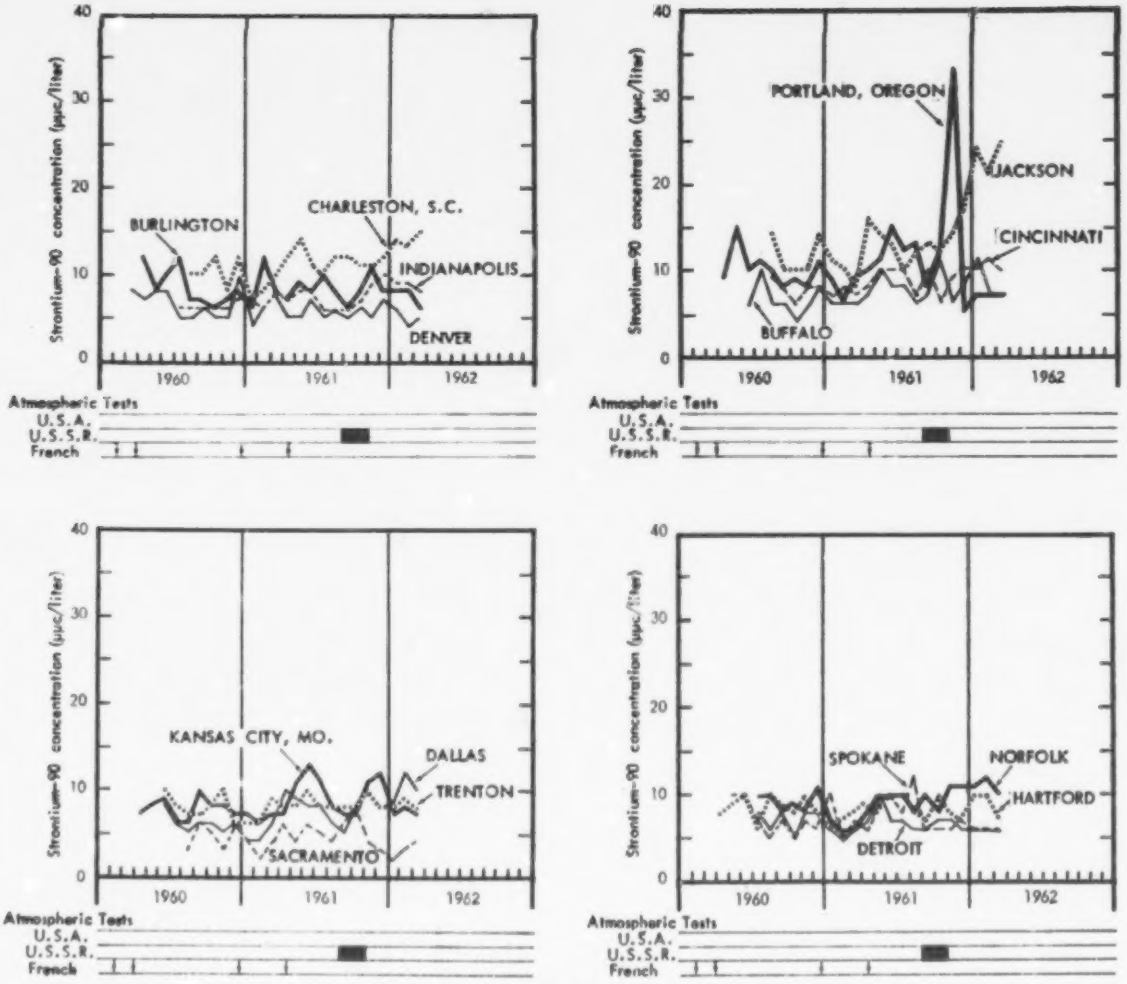

FIGURE 2.—STRONTIUM-90 CONCENTRATIONS IN PASTEURIZED MILK

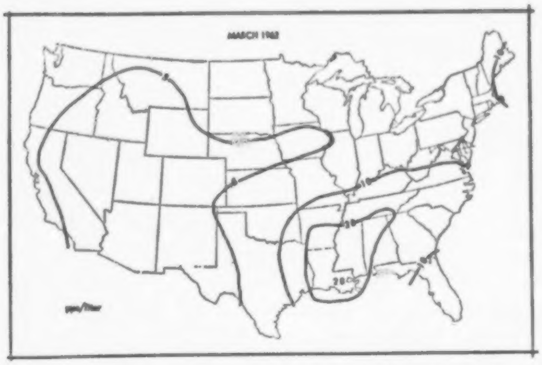

FIGURE 3.—STRONTIUM-90 ISOCONCENTRATION CONTOURS FOR PASTEURIZED MILK, MARCH 1962

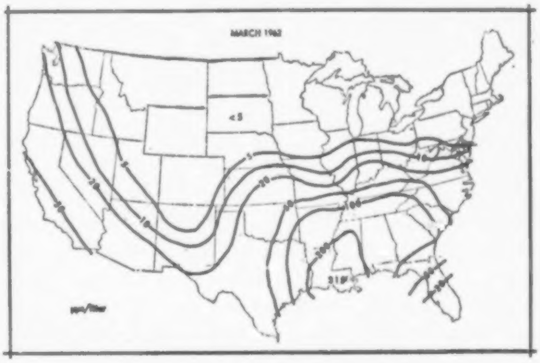

FIGURE 4.—STRONTIUM-89 ISOCONCENTRATION CONTOURS FOR PASTEURIZED MILK, MARCH 1962

TABLE 1.—RADIOACTIVITY IN PASTURIZED MILK, MARCH 1962

[Average radioactivity concentrations in $\mu\mu c$/liter]

Area		Calcium (gm/liter)		Strontium-89		Strontium-90		Iodine-131		Cesium-137		Barium-140	
City	State	First quarter	Av. for month	First quarter	Av. for month	First quarter	Av. for month	First quarter	Av. for month	First quarter	Av. for month	First quarter	Av. for month
Montgomery	Ala.	1.14	1.21	40	110	12	14	<10	<10	20	20	20	20
Palmer	Alaska	1.05	1.07	5	<5	6	6	<10	10	10	10	<10	10
Phoenix	Ariz.	1.05	1.07	25	25	3	3	<10	10	5	10	<10	10
Little Rock	Ark.	1.18	1.17	105	160	22	23	<10	<10	25	80	20	20
Sacramento	Calif.	1.07	1.08	15	35	3	4	<10	<10	5	10	<10	<10
San Francisco	Calif.	1.10	1.14	40	90	5	8	10	10	10	20	<10	10
Denver	Colo.	1.07	1.10	10	<5	5	5	<10	<10	10	10	<10	<10
Hartford	Conn.	1.14	1.15	<5	<5	9	7	<10	<10	5	<5	<10	<10
Wilmington	Del.	1.17	1.18	5	10	10	9	<10	<10	5	10	<10	<10
Washington	D. C.	1.16	1.17	<5	<5	8	7	<10	<10	<5	<5	<10	<10
Tampa	Fla.	1.22	1.19	20	20	7	6	<10	<10	55	70	<10	<10
Atlanta	Ga.	1.19	1.21	120	130	13	14	<10	<10	30	60	20	20
Honolulu	Hawaii	1.04	1.03	50	30	5	4	10	20	10	20	<10	10
Idaho Falls	Idaho	1.09	1.06	<5	<5	4	4	10	10	5	5	[illegible]	<10
Chicago	Ill.	1.13	1.13	<5	<5	6	5	<10	<10	<5	<5	<10	<10
Indianapolis	Ind.	1.20	1.20	10	20	9	8	<10	<10	5	<5	<10	<10
Des Moines	Iowa	1.07	1.09	5	<5	5	5	<10	10	10	10	<10	10
Wichita	Kans.	1.07	1.10	20	30	7	7	<10	<10	5	10	<10	10
Louisville	Ky.	1.17	1.17	20	35	11	9	<10	<10	10	15	<10	<10
New Orleans	La.	1.22	1.23	325	315	28	28	<10	<10	70	100	50	40
Portland	Maine	1.20	1.22	<5	<5	11	10	<10	<10	15	20	<10	<10
Baltimore	Md.	1.17	1.18	<5	<5	9	8	<10	<10	5	<5	<10	<10
Boston	Mass.	1.19	1.19	<5	<5	10	10	<10	<10	15	20	<10	<10
Detroit	Mich.	1.16	1.18	<5	<5	6	6	<10	<10	<5	<5	<10	<10
Grand Rapids	Mich.	1.19	1.20	<5	<5	5	8	<10	<10	10	20	<10	<10
Minneapolis	Minn.	1.07	1.11	5	<5	6	6	10	20	10	10	<10	10
Jackson	Miss.	1.27	1.26	245	220	23	25	<10	<10	40	70	40	40
Kansas City	Mo.	1.05	1.09	15	20	7	7	10	10	10	10	<10	10
St. Louis	Mo.	1.07	1.12	10	10	8	8	<10	10	10	10	10	20
Helena	Mont.	1.08	1.10	5	5	4	4	20	20	<5	<5	<10	<10
Omaha	Nebr.	1.09	1.16	10	5	5	5	<10	10	5	10	<10	10
Manchester	N. H.	1.17	1.16	<5	<5	10	10	<10	<10	25	30	<10	<10
Trenton	N. J.	1.16	1.17	<5	<5	8	8	<10	<10	5	15	<10	<10
Albuquerque	N. Mex.	1.07	1.11	10	<5	4	3	20	20	<5	<5	10	10
Buffalo	N. Y.	1.13	1.16	<5	<5	8	7	<10	<10	5	10	<10	<10
New York	N. Y.	1.13	1.12	<5	<5	9	8	<10	<10	<5	<5	<10	<10
Syracuse	N. Y.	1.14	1.14	<5	5	7	6	<10	<10	5	10	<10	<10
Charlotte	N. C.	1.20	1.20	25	35	12	13	<10	<10	<5	<5	<10	<10
Minot	N. D.	1.04	1.06	<5	<5	8	8	<10	10	10	10	<10	10
Cincinnati	Ohio	1.12	1.18	15	25	10	10	<10	<10	<5	<5	<10	<10
Cleveland	Ohio	1.16	1.15	<5	<5	8	8	<10	<10	5	10	<10	<10
Oklahoma City	Okla.	1.17	1.16	40	40	9	8	<10	<10	<5	<5	<10	<10
Portland	Oreg.	1.08	1.14	25	20	7	7	<10	<10	15	20	<10	10
Philadelphia	Pa.	1.16	1.17	<5	<5	9	10	<10	<10	<5	<5	<10	<10
Pittsburgh	Pa.	1.17	1.15	<5	5	11	8	<10	<10	<5	<5	<10	<10
San Juan	P. R.	1.14	1.16	110	90	8	9	<10	<10	25	40	20	<10
Providence	R. I.	1.16	1.16	<5	<5	9	9	<10	<10	10	20	<10	<10
Charleston	S. C.	1.22	1.23	80	95	14	15	<10	<10	25	40	10	10
Rapid City	S. D.	1.09	1.05	10	<5	6	6	10	20	15	15	10	30
Chattanooga	Tenn.	1.24	1.25	110	190	15	20	<10	<10	30	50	20	20
Memphis	Tenn.	1.21	1.20	120	125	15	16	<10	<10	<5	<5	20	20
Austin	Tex.	1.16	1.17	25	30	5	7	<10	<10	<5	<5	<10	<10
Dallas	Tex.	1.21	1.18	55	80	10	10	<10	<10	5	10	<10	<10
Salt Lake City	Utah	1.08	1.08	<5	<5	4	3	10	10	5	5	<10	<10
Burlington	Vt.	1.16	1.15	<5	<5	7	6	<10	<10	10	<5	<10	<10
Norfolk	Va.	1.22	1.25	20	40	11	10	<10	<10	5	10	<10	<10
Seattle	Wash.	1.07	1.10	15	10	6	6	<10	10	15	[illegible]	<10	10
Spokane	Wash.	1.07	1.10	<5	<5	6	6	10	20	[illegible]	10	<10	10
Charleston	W. Va.	1.15	1.16	10	10	9	8	<10	<10	<5	<5	<10	<10
Milwaukee	Wis.	1.20	1.20	<5	<5	6	5	<10	<10	5	<5	<10	<10
Laramie	Wyo.	1.05	1.07	<5	<5	4	4	10	10	10	10	<10	10
Network average		1.14	1.15	30	35	8.7	8.6	<10	<10	11	16	<10	<10

tle during the winter on silage harvested prior to the resumption of atmospheric nuclear weapons testing and dairy cattle in the South feeding on pasture contaminated by relatively fresh fission products. Strontium–90 concentrations have shown no marked upward change during March 1962 except for minor fluctuations which occur normally from month to month. Iodine–131 concentrations in milk continue to be less than the minimum level of detection at most stations during March.

Table 1 presents a summary of all available analyses for March 1962. These data are an average of weekly samples in most instances.

When a radionuclide is reported by the laboratory as being below the minimum detectable concentration, one-half of this value is used for calculating the monthly average. A similar procedure is used for the network average.

Editor's note: Preliminary data for May 1962 indicate that increased amounts of iodine–131 have appeared in pasteurized milk samples from a number of states located mostly in mid-continental sections of the U. S. The normal weekly sampling schedule has been increased to a semi-weekly sampling interval.

STRONTIUM–90 IN MINNESOTA MILK
May 1961–February 1962

Division of Environmental Sanitation
Minnesota Department of Health

The Minnesota State Department of Health, Division of Environmental Sanitation, initiated a small bovine milk surveillance network in September 1958. Two-ounce samples, collected daily at each of the network stations (see figure 1) are composited and analyzed monthly for strontium–90. Collection is made at the bottling machines so that the sample is randomly representative of the milk produced in that milkshed. The most recently reported data from this network are presented in table 2.

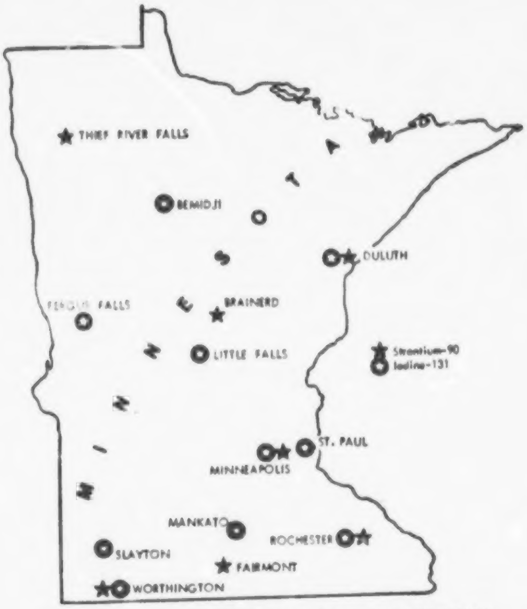

FIGURE 5.—MINNESOTA MILK SAMPLING LOCATIONS

In October 1961, following the resumption of atmospheric nuclear weapons testing by the U.S.S.R., a special network of sampling stations (see figure 5) was established for the collection of "grab" milk samples at milk processing plants for analysis of iodine–131 concentrations. Data for October–December 1961 were published in the March 1962 *RHD*. During January and February 1962, iodine–131 concentrations were not detectable.

Previous coverage in *Radiological Health Data:*

Period	*Issue*
September 1958–August 1959	April 1960
September 1958–December 1959	July 1960
January–April 1960	December 1960
May–November 1960	June 1961
December 1960–April 1961	October 1961
October–December 1961 (iodine–131 data)	March 1962

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TABLE 2.—STRONTIUM-90 IN MINNESOTA MILK, MAY 1961–FEBRUARY 1962

[Concentrations in $\mu\mu c$/liter]

Month	Brainerd	Duluth	Fairmont	Minneapolis	Rochester	Thief River Falls	Worthington
1960 Average	16	13	—	7	6	9	7
May 1961	17	16	—	7	8	8	8
June 1961	13	14	—	8	6	6	—
July 1961	16	12	—	12	8	7	—
August 1961	16	14	—	10	21	10	—
September 1961	17	10	—	6	4	6	—
October 1961	—	14	—	7	5	8	—
November 1961	4	10	4	8	4	7	—
December 1961	13	15	6	7	6	5	—
1961 Average	*13.1	13.3	*5	7.9	7.2	*7.0	*6.4
January 1962	—	10	4	6	6	6	—
February 1962	11	—	4	6	—	5	—

* Average based on less than 12 months' data.

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SECTION IV.—WATER

Radioactivity in Raw Surface Waters

NATIONAL WATER QUALITY NETWORK
February 1962

Division of Water Supply & Pollution Control, Public Health Service

The National Water Quality Network, operated in cooperation with State and local agencies and industrial organizations, commenced operations in October 1957. By the end of February 1962, 106 sampling stations were submitting water samples for analyses. These stations are located on major waterways used for public water supply, propogation of fish and wildlife, recreational purposes, and for agricultural, industrial, and other uses. Some of these stations are on interstate, coastal, and international boundary waters, and waters on which activities of the Federal Government may have an impact. Ultimately, a total of approximately 300 stations will be in operation. Radioactivity is not yet being reported for a few of the more recently established stations.

Samples of water are examined for chemical, physical, and biological quality insofar as these relate to pollution. Samples for some determinations are taken weekly, others monthly, and for some, continuous composite samples of 10 to 15 days are obtained.

Gross alpha and beta measurements are made on both suspended and dissolved solids (strontium-90 on the total solids only) in raw surface water samples. The levels of radioactivity associated with dissolved solids provide a rough measure of the levels which may be found in treated water, where such water treatment removes substantially all of the suspended matter. Naturally-occurring radioactive substances in the environment are the source of essentially all of the alpha activity. The contamination of the environment from man-made sources is the major contributor to the beta activity. It should be noted that with the cessation of weapons testing for a period of three years, the beta activity in most raw waters generally had approached a level attributable solely to natural sources. Natural beta activity can be two or three times the natural alpha activity based on the presence of the same nuclides. The resumption of nuclear weapons testing in the atmosphere has resulted in an increase in radioactivity of surface waters.

For the first two years of the Network operations, beta determinations were made on weekly samples. Alpha determinations were reported generally on composites of more than one weekly sample. Since January 1959, a portion of each sample from all stations in the Network has been composited into a three-month sample for measurement of strontium-90 concentration.

Beginning January 1, 1960, the frequency of beta determinations varied depending on the status of each particular station. For the first operating year of each new station, analyses were being conducted weekly. Weekly analyses were to be continued indefinitely for all stations which may be affected by waste discharges from nuclear installations. Semimonthly determinations (on composites of 2 or 3 weekly samples) were conducted for stations which still showed some beta activity above background. Monthly determinations (on composites of all samples received from a station during the month) were conducted on samples from streams where beta activity was at background levels.

Beginning January 1, 1960, the frequency of alpha determinations also was changed. For the first operating year of each new station, analyses were to be done weekly. At some stations on the Colorado and Animas Rivers determinations were done on weekly samples or semimonthly on two- or three-week composites. The remainder of the stations were scheduled so that each made one gross alpha determination per month.

Following the resumption of nuclear weapons testing in the atmosphere, the gross beta and alpha determination schedules were altered. Since September 1, 1961, gross beta determinations have been made on all samples collected (compositing weekly samples for monthly or semimonthly gross beta or alpha determinations will cease). Since October 1, 1961, gross alpha determinations have been made on one sample from each station each month, unless there is evidence of alpha activity in excess of background levels. In the latter instance, an alpha determination has been made on a weekly or bi-weekly basis, depending on what is considered the norm for a particular station.

The data reported in table 1 represent the average of all data reported for the periods indicated. The reported strontium-90 data are the results of determinations on three-month composite samples for the quarter ending in the month shown.

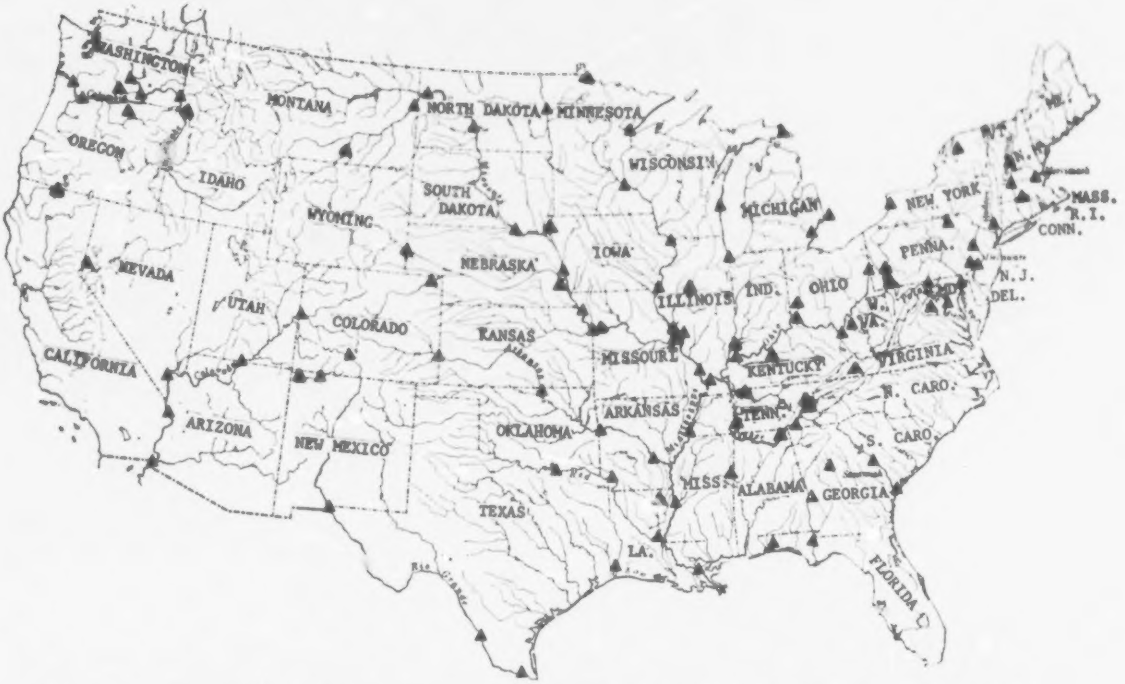

FIGURE 1.—NATIONAL WATER QUALITY NETWORK SAMPLING STATIONS, FEBRUARY 1962

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TABLE 1.—RADIOACTIVITY IN RAW SURFACE WATERS

[Average concentrations in μμc/liter]

Station	Quarter ending Dec. 31, 1961	February 1962					
	Strontium-90	Beta activity			Alpha activity		
	Total	Suspended	Dissolved	Total	Suspended	Dissolved	Total
Allegheny River: Pittsburgh, Pa	0.3	3	16	19	0	0	0
Animas River: Cedar Hill, N. Mex	0.3	11	32	43	2	4	6
Apalachicola River: Chattahoochie, Fla	0.4	28	24	52	1	0	1
Arkansas River:							
Coolidge, Kans	—	18	149	167	0	45	45
Ponca City, Okla	—	87	58	145	0	2	2
Pendleton Ferry, Ark	—	107	37	144	—	—	—
Big Horn River: Hardin, Mont	—	64	46	110	5	4	9
Big Sioux River: Sioux Falls, S. Dak	0.4	56	174	230	0	3	3
Chattahoochie River:							
Atlanta, Ga	—	10	12	22	1	0	1
Columbus, Ga	—	34	16	50	1	1	2
Clear Water River: East Lewiston, Idaho	—	22	20	42	1	1	2
Colorado River:							
Loma, Colo	—	58	44	102	2	9	11
Page, Ariz	—	66	54	122	21	8	29
Boulder City, Nev	1.0	5	25	30	<1	8	8
Parker Dam, Calif	—	26	39	65	0	9	9
Columbia River:							
Wenatchee, Wash	—	4	8	12	0	1	1
Pasco, Wash	1.1	61	483	544	—	—	—
Bonneville Dam, Oreg	*0.6	30	265	295	0	0	0
Clatskanie, Oreg	—	27	137	164	0	0	0
McNary Dam, Oreg	1.2	79	350	429	0	1	1
Connecticut River:							
Northfield, Mass	0.4	15	16	31	0	0	0
Wilder, Vt	—	6	12	18	0	0	0
Cumberland River: Clarksville, Tenn	0.4	5	17	22	—	—	—
Delaware River:							
Martins Creek, Pa	—	10	18	28	0	0	0
Trenton, N. J	—	21	23	44	0	1	1
Escambia River: Century, Fla	*0.9	37	21	58	1	0	1
Great Lakes:							
Buffalo, N. Y	—	2	8	10	—	—	—
Detroit, Mich	*0.6	7	10	17	0	0	0
Port Huron, Mich	0.4	4	10	14	0	0	0
Milwaukee, Wis	—	5	9	14	1	1	2
Sault Ste. Marie, Mich	—	5	5	10	0	0	0
Gary, Ind	0.2	8	7	15	0	0	0
Duluth, Minn	—	1	3	4	0	0	0
Hudson River: Poughkeepsie, N. Y	0.2	14	38	52	0	0	0
Illinois River:							
Peoria, Ill	0.4	25	43	68	1	0	1
Grafton, Ill	—	60	47	107	4	1	5
Kanawha River: Winfield Dam, W. Va	—	11	14	25	—	—	—
Klamath River: Copco, Oreg	—	12	18	30	—	—	—
Little Miami River: Cincinnati, Ohio	1.1	21	32	53	0	0	0
Merrimack River: Lowell, Mass	*0.7	—	—	—	—	—	—
Mississippi River:							
St. Paul, Minn	0.9	2	11	13	0	2	2
Dubuque, Iowa	—	7	17	24	0	1	1
Burlington, Iowa	0.6	20	19	39	1	1	2
E. St. Louis, Ill	—	24	78	102	2	0	2
Cape Giraudeau, Mo	0.8	54	31	85	1	2	3
West Memphis, Ark	—	55	30	85	4	1	5
Delta, La	*0.4	54	29	83	2	1	3
New Orleans, La	—	72	30	102	8	0	8
Vicksburg, Miss	—	68	35	103	2	<1	2
Missouri River:							
Williston, N. Dak	—	19	25	44	1	2	3
Bismarck, N. Dak	—	4	16	20	0	4	4
Yankton, S. Dak	0.6	24	20	44	4	3	7
Omaha, Nebr	—	19	39	58	1	3	4
St. Joseph, Mo	—	80	28	108	0	0	0
Kansas City, Kans	2.3	94	30	124	—	—	—
St. Louis, Mo	1.4	45	32	77	—	—	—

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TABLE 1.—RADIOACTIVITY IN RAW SURFACE WATERS—Continued

[Average concentrations in $\mu\mu c$/liter]

Station	Quarter ending Dec. 31, 1961	February 1962					
	Strontium-90	Beta activity			Alpha activity		
	Total	Suspended	Dissolved	Total	Suspended	Dissolved	Total
Monongahela River: Pittsburgh, Pa.	0.4	9	17	26	0	0	0
North Platte River: Henry, Nebr.	—	9	63	72	0	24	24
Ohio River:							
East Liverpool, Ohio	0.4	13	20	33	0	1	1
Huntington, W. Va.	—	18	14	32	0	0	0
Cincinnati, Ohio	—	21	11	32	1	0	1
Louisville, Ky.	0.4	24	16	40	1	<1	1
Evansville, Ind.	—	38	20	58	2	0	2
Cairo, Ill.	1.1	59	30	89	2	0	2
Platte River: Plattsmouth, Nebr.	—	30	46	76	1	7	8
Potomac River:							
Williamsport, Md.	—	40	26	66	0	0	0
Great Falls, Md.	—	17	11	28	0	0	0
Rainy River:							
Baudette, Minn.	—	15	9	24	1	0	1
International Fls. Minn.	—	1	9	10	0	<1	<1
Red River, South:							
Index, Ark.	—	33	46	79	—	—	—
Alexandria, La.	1.0	70	38	108	6	0	6
Denison, Tex.	—	10	61	71	0	1	1
Rio Grande River:							
Alamosa, Colo.	*0.4	17	24	41	0	1	1
El Paso, Tex.	—	4	20	24	0	3	3
Laredo, Tex.	—	7	21	28	0	0	0
Brownsville, Tex.	—	9	24	33	2	1	3
Roanoke River: John H. Kerr Resr. & Dam, Va.	—	35	20	55	1	<1	1
Sabine River: Ruliff, Tex.	—	48	48	96	—	—	—
San Juan River: Shiprock, N. Mex.	—	20	26	46	1	14	15
St. Laurence River: Massena, N. Y.	—	4	9	13	0	0	0
Schuylkill River: Philadelphia, Pa.	—	16	26	42	0	0	0
Savannah River:							
North Augusta, S. C.	—	17	10	27	—	—	—
Port Wentworth, Ga.	0.4	21	39	60	0	0	0
Shenandoah River: Berryville, Va.	—	11	18	29	<1	1	1
Snake River:							
Wawawai, Wash.	0.3	12	14	26	0	2	2
Payette, Idaho	—	29	31	60	1	4	5
South Platte River: Julesburg, Colo.	0.7	27	38	65	3	38	41
Susquehanna River:							
Sayre, Pa.	0.3	6	20	26	0	0	0
Conowingo, Md.	0.3	5	18	23	0	0	0
Tennessee River:							
Lenoir City, Tenn.	—	28	21	49	<1	0	<1
Chattanooga, Tenn.	0.6	28	48	76	1	0	1
Bridgeport, Ala.	0.7	—	—	—	—	—	—
Pickwick Landing, Tenn.	—	61	45	106	<1	0	<1
Tombigbee River: Columbus, Miss.	—	57	30	87	1	0	1
Truckee River: Farad, Calif.	—	45	42	87	<1	<1	<1
Wabash River: New Harmony, Ind.	—	144	64	208	3	1	4
Yakima River: Richland, Wash.	0.4	10	11	21	0	1	1
Yellowstone River: Sidney, Mont.	—	25	58	83	1	7	8

* April-September Strontium-90 data.

Radioactivity in Drinking Water

DRINKING WATER ANALYSIS PROGRAM 1961

Division of Environmental Engineering and Food Protection, Public Health Service

The Water Supply Section of the Interstate Carrier Branch, Division of Environmental Engineering and Food Protection, PHS, has gathered extensive data on the radioactivity content of water supplies used on interstate carriers such as trains, airplanes, ships, and other conveyances operating in interstate commerce. This work has several objectives, among which are:

1. to determine radioactivity content of interstate carrier water supplies for comparison with the revised Public Health Service Drinking Water Standards;

2. to establish the radioactivity background level as the base with which to compare future results from the supplies sampled; and
3. to obtain data for study in connection with the occurrence of certain chronic diseases.

Initiated in November 1960, the project is a continuing one under which it is planned to cover ultimately the 850 U. S. water supplies used by interstate carriers. Figure 1 shows the nationwide distribution of the 140 municipalities included in the first sampling. In many instances, there are several sources for a municipality and each is sampled. A second sampling of these cities is underway at the present time. When this is complete, another group of about 100 will be chosen.

Each sample is a composite of 3 aliquots a day obtained during a two week period. The analyses for gross alpha, gross beta, and strontium-90 are performed at the Southeastern and Southwestern Radiological Health Laboratories, operated by the Division of Radiological Health.

Table 1 presents additional data from the first sampling. The data will be published on a regular basis as it becomes available.

Previous coverage in *Radiological Health Data:*

Period	*Issue*
1961	May 1962

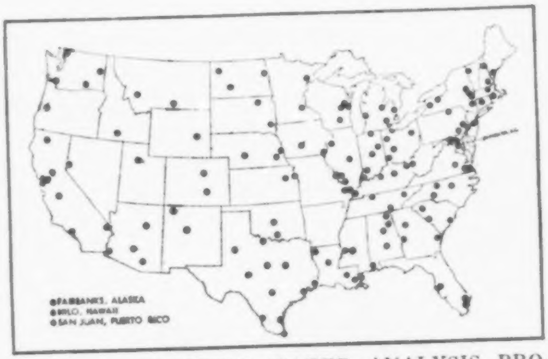

FIGURE 1.—DRINKING WATER ANALYSIS PROGRAM SAMPLING STATIONS

TABLE 1.—RADIOACTIVITY IN DRINKING WATERS (1961)
[Concentrations in μμc/liter]

Station location		Estimated population served	Date sampled	Sr^{90}	Alpha activity			Beta activity		
City	State			Total solids	Suspended	Dissolved	Total	Suspended	Dissolved	Total
Phoenix:	Ariz	304,000								
Sampling Point 1			7/25-8/8	[a]—	[b]•	•	•	<1.0	<1.0	<2.0
Sampling Point 2			7/25-8/8	—	•	•	•	<1.0	6.6	<7.6
Sampling Point 3			5/15-5/28	—	—	—	—	—	—	—
Sampling Point 4			7/25-8/8	—	•	•	•	<1.0	6.3	<7.3
Sampling Point 5			7/25-8/8	—	•	•	•	<1.0	5.2	<6.2
Sampling Point 6			7/25-8/8	—	•	•	•	<1.0	6.2	<7.2
Fort Lauderdale:	Fla	114,500								
Dixie Plant			4/27-5/11	—	•	•	•	<3.0	5.4	<8.4
Fiveash Plant			4/27-5/12	—	•	•	•	<3.0	<3.0	<6.0
Miami:	Fla	500,000								
Hialeah Plant			3/16-3/31	<1.0	•	•	•	<3.0	<3.0	<6.0
Orr Plant			3/16-3/31	<1.0	•	•	•	<3.0	<3.0	<6.0
Indianapolis:	Ind	530,000								
White River Plant			1/17-2/1	0.3	•	•	—	<2.6	3.2	<5.8
Fall Creek Plant			1/17-2/1	0.3	•	•	—	<2.6	<2.6	<5.2
Shreveport:	La	193,700								
Cross Lake Plant			8/7-8/25	—	—	—	—	<3.0	4.0	<7.0
McNeill St. Plant			8/7-8/25	—	—	—	—	<3.0	4.4	<7.4
Baltimore:	Md	1,367,000								
Montebello Plant			10/30-11/13	—	—	—	—	<3.0	4.6	<7.6
Ashburton Plant			10/27-11/10	—	—	—	—	<3.0	6.8	<9.8
Lowell	Mass	97,000	3/16-3/30	—	•	•	•	<3.0	<3.0	<6.0
Monroe	Mich	23,000	4/19-5/3	—	•	•	•	<3.0	4.6	<7.6
Port Huron	Mich	37,800	4/21-5/5	—	•	•	•	<3.0	2.9	<5.9
Greenville	Miss	45,000	1/12-1/27	0.5	—	•	•	<2.6	<2.6	<5.2
North Platte	Neb	15,500	10/24-11/7	—	0.3	11.4	11.7	0.3	14.1	14.4
Bismarck	N. D	23,000	7/18-8/5	—	•	•	•	<1.0	6.6	<7.6
Williston	N. D	10,500	8/29-9/13	—	1.1	14.4	15.5	0.7	12.8	13.5
Toledo	Ohio	425,000	8/17-9/3	—	—	—	—	<3.0	<3.0	<6.0
Ardmore	Okla	26,000	2/8-2/23	0.7	—	•	•	—	<2[illegible]	—
Aberdeen	S. D	24,000	8/28-9/12	—	9.4	—	9.4	3.8	15.3	19.1
Sioux Falls	S. D	65,000	9/1-9/15	—	8.9	19.9	28.8	0.1	9.1	9.2
Brownsville:	Tex	50,000								
Plant No. 1			3/30-4/13	—	•	•	•	<3.0	5.0	<8.0
Plant No. 2			3/29-4/12	<1.0	•	•	•	<3.0	3.1	<6.1
Norfolk:	Va	300,000								
Moores Bridge Plant			5/15-5/29	—	•	•	•	<3.0	3.5	<6.5
37th Street Plant			5/16-5/30	—	•	•	•	<3.0	<3.0	<6.0

[a] Dash indicates no determination reported.
[b] • indicates quantity not measurable.

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Radioactivity in Minnesota Surface and Ground Waters
August 1959–April 1962

Division of Environmental Sanitation
Minnesota Department of Health

The analysis of various Minnesota waters for radioactivity concentrations was initiated late in 1956 as part of the Minnesota Water Pollution Control Program. This program was expanded in 1958 to include most of the surface municipal water supplies in the State as well as a representative number of ground water supplies and selected lakes throughout the State. Monthly grab samples are usually obtained on raw and treated waters.

Table 1 presents the gross beta data in surface waters for August 1959 through April 1962. The beta activity concentrations in the raw water samples ranged from non-detectable to 234 μμc/liter. Treated water had concentrations ranging from non-detectable to 220 μμc/liter. Figure 1 shows the surface water sampling locations.

The average concentrations of gross alpha activity from selected wells in each Minnesota District are grouped according to their geological formation and presented in table 2. Table 2 shows the ground water sampling districts.

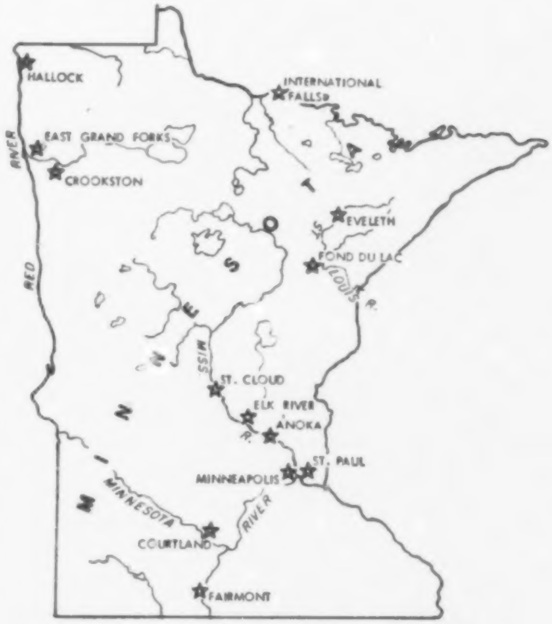

FIGURE 1.—SURFACE WATER SAMPLING LOCATIONS

TABLE 1.—GROSS BETA CONCENTRATIONS IN MINNESOTA SURFACE WATERS
August 1959–April 1962

[Concentrations in μμc/liter]

Town and water source	Sampling date		Raw water	Treated water
Anoka—Mississippi River	1959	October 29	—[a]	9
	1960	May 18	—	14
		September 29		4
	1961	April 6	3	[b]ND
		August 29	15	40
Courtland—Minnesota River	1959	November 19	—	25
	1960	April 11	—	22
Crookston—Red Lake River	1959	January 19	30	6
		February 10	100	6
		March 5	2	15
		April 20	81	40
		May 6	80	41
		June 3	36	26
		July 13	26	34
		August 12	94	66
		September 15	18	42
		October 6	23	16
	1960	January 14	22	26
		February 15	24	12
		March 8	6	2
		April 6	17	35
		May 10	5	ND
		June 27	ND	29
Crookston—Con.		July 18	36	29
		August 29	30	4
		September 6	5	21
		October 10	17	ND
		November 10	12	23
		December 2	26	22
	1961	January 9	4	6
		Febuary 7	13	14
		March 13	17	22
		April 11	28	16
		May 22	28	8
		June 5	9	12
		July 5	11	23
		August 7	234	55
		September 8	36	27
		October 5	14	17
		November 13	32	52
		December 8	28	46
		December 27	34	24
	1962	January 31	ND	ND
		March 16	ND	ND
		April 4	48	ND
East Grand Forks—Red Lake River	1961	November 21	37	32

[a] Dash indicates no analysis performed.
[b] ND indicates beta activity not detectable.

TABLE 1.—GROSS BETA CONCENTRATION IN MINNESOTA SURFACE WATERS—Continued
August 1959–April 1962
[Concentrations in μμc/liter]

Town and water source	Sampling date		Raw water	Treated water
East Grand Forks—Con.		November 30	68	33
		December 6	38	37
		December 11	28	9
		December 18	37	18
		December 27	32	5
	1962	January 2	30	10
		January 8	34	27
		January 15	21	23
		January 22	ND	ND
		January 29	ND	ND
		February 5	38	ND
		February 12	28	ND
		February 21	30	25
		March 5	ND	ND
		March 16	28	ND
		March 22	25	ND
		April 4	42	ND
		April 11	89	51
		April 16	58	ND
Elk River—Mississippi River	1959	October 29	17	—
	1960	May 18	ND	—
		September 29	4	—
	1961	February 17	9	—
		April 6	21	—
		August 29	144	—
Eveleth—St. Mary's Lake	1961	November 21	30	15
		November 29	40	33
		December 6	45	59
		December 9	26	25
		December 18	17	17
		December 26	24	18
	1962	January 2	28	12
		January 8	24	37
		January 12	ND	ND
		January 22	ND	ND
		January 29	22	ND
		February 2	ND	ND
		February 9	ND	ND
		February 13	ND	ND
		February 21	ND	ND
		February 27	ND	ND
		March 5	ND	25
		March 22	25	ND
		April 4	29	26
		April 11	ND	ND
		April 16	ND	ND
Fairmont—Budd Lake	1961	November 21	87	26
		November 30	58	17
		December 6	70	34
		December 18	49	15
		December 28	45	42
	1962	January 3	50	30
		January 8	32	52
		January 15	32	43
		January 22	ND	ND
		January 29	32	ND
		February 5	ND	ND
		February 12	30	ND
		February 21	28	ND
		February 27	42	ND
		March 16	ND	ND
		April 4	50	38
		April 11	71	41
		April 16	40	ND
Fond du Lac—St. Louis River	1959	November 11	—	18
		December 16	—	18
	1960	May 11	—	9
		September 22	—	4
		October 27	—	9
		December 8	—	ND
Hallock—Two Rivers South Fork	1961	November 21	46	30
		November 30	26	23
		December 9	26	4
		December 14	21	14
		December 21	20	146
		December 27	17	3
Hallock—Con.	1962	January 3	26	20
		January 11	43	27
		January 18	46	19
		January 25	150	ND
		January 31	ND	ND
		February 8	ND	ND
		February 13	ND	ND
		February 21	ND	ND
		February 27	ND	ND
		March 5	ND	ND
		March 22	ND	ND
		April 4	54	ND
		April 16	42	ND
International Falls—Rainy River	1960	January 14	20	14
		February 15	16	6
		March 8	14	11
		April 6	10	11
		May 10	ND	16
		July 13	21	7
		August 29	44	ND
		September 7	4	11
		October 7	ND	ND
		November 10	18	9
		December 2	14	12
	1961	January 9	15	15
		May 22	16	33
		June 5	5	5
		June 3	18	22
		August 7	ND	17
		September 8	30	34
		October 5	38	27
		November 13	32	36
		December 11	24	4
	1962	January 3	12	17
		February 2	ND	ND
		March 5	ND	ND
		April 4	ND	ND
Minneapolis-Mississippi River	1959	September 2	47	20
		September 8	ND	20
		September 15	ND	ND
		September 22	ND	ND
		September 29	24	18
		October 6	19	7
		October 13	11	8
		October 27	17	10
		November 2	17	14
		November 9	12	13
		December 22	8	30
		December 28	ND	2
	1960	January 5	12	12
		January 12	7	6
		January 20	17	9
		January 26	14	12
		February 3	18	14
		February 8	12	16
		February 16	4	ND
		February 23	8	14
		March 2	8	18
		March 8	5	ND
		March 17	1	12
		March 23	25	ND
		March 29	17	4
		April 6	14	9
		April 11	20	20
		April 19	24	2
		April 28	12	4
		May 5	16	8
		May 10	44	11
		May 18	6	7
	1961	September 27	—	30
		October 2	—	33
		October 3	—	56
		October 4	—	66
		October 5	—	16
		October 9	—	15
		October 10	—	19

TABLE 1.—GROSS BETA CONCENTRATION IN MINNESOTA SURFACE WATERS—Continued
August 1959—April 1962

[Concentrations in $\mu\mu c$/liter]

Town and water source	Sampling date	Raw water	Treated water
Minneapolis—Con.	October 11	—	34
	October 13	—	7
	October 16	—	32
	October 17	—	70
	October 20	—	44
	October 25	—	27
	October 26	—	34
	October 27	—	28
	October 30	—	220
	November 1	—	26
	November 2	—	29
	November 3	—	22
	November 6	—	44
	November 8	—	100
	November 9	—	52
	November 15	—	40
	November 16	—	42
	November 17	—	36
	November 20	—	40
	November 22	—	24
	November 24	—	13
	November 28	—	37
	November 29	—	3
	December 1	—	9
	December 4	—	5
	December 6	—	7
	December 8	—	15
	December 13	—	12
	December 15	—	15
	December 18	—	17
	December 27	—	34
	1962 January 30	—	ND
	Feruary 6	—	ND
	February 27	—	ND
	March 6	—	ND
	March 7	—	ND
	March 8	—	ND
	April 12	—	ND
Saint Cloud—Mississippi River	1960 January 14	11	6
	February 23	17	11
	March 8	13	1
	May 10	ND	13
	June 27	22	29
	July 14	7	29
	August 29	33	14
	September 7	6	10
	October 11	31	4
	November 10	9	7
	December 1	18	13
	1961 January 10	18	13
	February 7	12	14
	March 13	9	10
	April 11	8	18
	May 22	8	4
	June 5	13	30
	July 3	6	1
	August 7	6	12
	September 8	60	44
	October 4	60	24
	November 4	85	44
	November 29	34	36
	1962 January 3	17	35
	January 31	25	ND
	February 13	ND	ND
	April 11	ND	ND
St. Paul—Vadnais Chain of Lakes	1959 September 2	ND	23
	September 10	24	20
	September 15	ND	ND
	September 22	1	24
	September 29	17	19
	October 6	20	15
	October 13	12	16
	October 19	16	16
	October 27	21	23
	November 2	30	16
	November 9	13	23
	November 18	20	15
	December 22	23	13
	December 30	14	ND
St. Paul—Con.	1960 January 12	12	18
	January 14	8	16
	January 20	16	5
	January 26	10	10
	February 3	8	17
	February 8	19	4
	February 16	14	15
	February 24	18	18
	March 2	17	18
	March 8	ND	ND
	March 17	7	ND
	March 23	20	8
	March 29	ND	ND
	April 6	15	10
	April 11	22	9
	April 19	10	4
	April 28	23	12
	May 5	16	12
	May 10	4	ND
	May 18	20	ND
	May 24	19	25
	June 3	20	18
	June 6	9	19
	June 13	13	13
	June 20	7	ND
	June 27	18	14
	July 5	4	22
	July 11	ND	ND
	August 1	22	13
	August 8	18	11
	August 15	13	13
	August 22	34	13
	August 29	26	18
	September 6	ND	16
	September 12	16	ND
	September 19	4	ND
	September 26	23	ND
	October 3	37	5
	October 10	19	ND
	October 17	11	16
	October 24	12	12
	October 31	12	12
	November 7	16	10
	November 14	3	2
	November 21	9	25
	November 28	10	6
	December 6	22	11
	December 13	16	8
	December 21	16	19
	December 22	13	ND
	1961 January 3	20	ND
	January 16	ND	2
	January 17	ND	13
	January 24	9	9
	January 31	9	11
	February 7	5	6
	February 16	24	6
	February 20	15	11
	February 28	20	5
	March 6	15	3
	March 13	14	6
	March 21	18	16
	March 28	22	1
	April 3	17	9
	April 11	24	11
	April 18	ND	10
	April 25	4	9
	May 2	ND	9
	May 11	29	27
	May 16	22	32
	May 23	45	ND
	May 31	ND	ND
	June 6	7	10
	June 13	2	7
	June 20	11	ND
	June 27	3	14
	July 5	10	17

TABLE 1.—GROSS BETA CONCENTRATIONS IN MINNESOTA SURFACE WATERS—Continued
August 1959–April 1962

[Concentrations in μμc/liter]

Town and water source	Sampling date	Raw water	Treated water
St. Paul–Con.	July 11	18	40
	July 18	24	39
	July 25	29	25
	August 1	11	10
	August 8	18	16
	August 15	19	21
	August 22	40	33
	August 29	30	24
	September 6	48	36
	September 12	34	22
	September 18	43	22
	September 26	52	78
	October 3	21	22
	October 10	24	21
	October 17	35	85
	October 24	7	38
	October 31	62	46
	November 7	36	29
	November 14	37	28
	November 21	28	34
St. Paul–Con.	November 28	46	37
	December 4	25	22
	December 11	27	34
	December 18	46	10
	December 26	33	34
	1962 January 2	64	29
	January 8	ND	ND
	January 15	34	20
	January 22	ND	ND
	January 29	ND	ND
	February 5	ND	ND
	February 12	ND	ND
	February 19	ND	ND
	February 27	ND	ND
	March 6	ND	ND
	March 22	27	28
	April 4	ND	ND
	April 11	ND	ND
	April 16	ND	ND

[a] Dash indicates no analysis performed.
[b] ND indicates beta activity not detectable.

TABLE 2—GROSS ALPHA CONCENTRATIONS IN MINNESOTA GROUND WATER

[Concentrations in μμc/liter]

District and sampling date	Geological formation	Number of locations	Maximum	Minimum	Average
I August 1961	Glacial drift (Pleistocene)	46	4.3	[a]ND	1.8
	Cretaceous sandstone	1	0.3	0.3	0.3
	Biwabik iron formation (Precambrian)	6	11.0	0.5	5.0
	Knife Lake slates (Precambrian)	1	3.7	3.7	3.7
	Keewatin greenstone (Precambrian)	1	1.9	1.9	1.9
II December 1961	Glacial drift (Pleistocene) or alluvium (Recent)	18	13	ND	1.6
	Sedimentary rocks				
	Devonian—Cedar Valley formation	2	31	ND	16
	Ordovician—Platteville, St. Peter, and Oneota formation	8	19	ND	5
	Cambrian—Jordan, and St. Lawrence formations	8	28	ND	8
	Cambrian—Franconia formation	4	21	ND	10
	Cambrian—Dresbach formation	9	20	ND	7
	Granite (Precambrian)	1	ND	ND	ND
III March 1960	Glacial drift (Pleistocene) or alluvium (Recent)	3	7.3	0.4	3.1
	Sedimentary rocks				
	Devonian—Cedar Valley formation	9	5.8	1.2	3.8
	Ordovician—Maquoketa and Galena formations	21	14.0	0.7	5.6
	Ordovician-Decorah, Platteville, Glenwood, and St. Peter formations	7	13.0	1.4	5.4
	Ordovician-Shakopee, Root Valley, and Oneota formations	[illegible]	7.3	ND	2.0
	Cambrian-Jordan and St. Lawrence formations	23	15.0	0.7	5.2
	Cambrian-Franconia and Dresbach formations	16	32.0	1.7	10.6
IV May 1961	Glacial drift (Pleistocene)	15	3.9	ND	0.9
	Hinckley sandstone (Cambrian)	1	5.6	5.6	5.6
	Biwabik iron formation (Precambrian)	2	1.9	1.8	1.8
	Slates (Precambrian)	2	3.4	ND	1.7
	Sandstone (Precambrian)	1	ND	ND	ND
V March 1961	Glacial drift (Pleistocene) or alluvium (Recent)	49	34.0	ND	5.8
	Sioux quartzite (Precambrian)	5	11.7	5.4	7.6
	Cretaceous sandstone	10	10.0	ND	2.9
VI February 1961	Glacial drift (Pleistocene) or alluvium (Recent)	14	4.5	ND	1.3
	Sedimentary rocks				
	Ordovician-Shakopee and St. Peter formations	5	13.0	1.1	5.7
	Cambrian-Jordan formation	22	17.0	ND	4.3
	Cambrian-St. Lawrence formation	4	12.8	0.3	6.5
	Cambrian-Franconia and Dresbach formations	29	60.5	ND	7.2
	Cambrian-Hickley formation	3	90.0	0.3	30.8

[a] ND indicates alpha activity is not detectable. When averaging, ND is assumed to be equal to zero.

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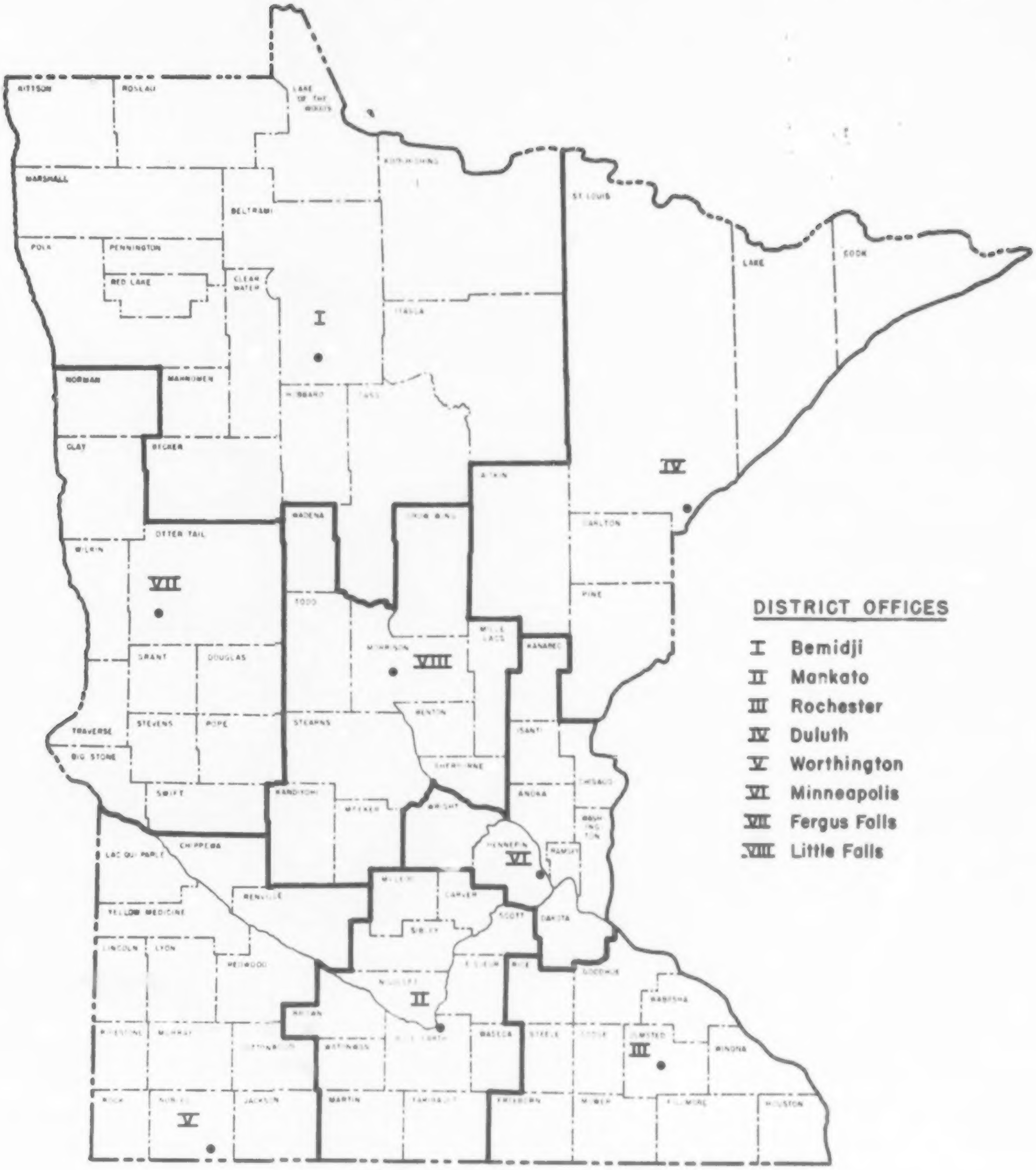

FIGURE 2.—SAMPLING DISTRICTS FOR MINNESOTA GROUND WATERS

SECTION V.—OTHER DATA

External Gamma Activity

Division of Radiological Health, Public Health Service

Daily measurements of external gamma radiation are made at stations of the Radiation Surveillance Network to assure detection of any substantial deviations from normal background levels. Portable Geiger-Mueller survey instruments are used to obtain measurements at three feet above the ground surface. May 1962 data reported in table 1 are characteristic of individual station observations which in recent years have defined the range of normal background values.

TABLE 1.—EXTERNAL GAMMA ACTIVITY, MAY 1962

Station location		Average (mr/hr)	Station location		Average (mr/hr)
City	State		City	State	
Adak	Alaska	0.01	Minneapolis	Mass.	0.01
Anchorage	Alaska	0.01	Jackson	Miss.	0.01
Attu	Alaska	0.01	Pascagoula	Miss.	[a]—
Cold Bay	Alaska	0.01	Jefferson	Mo.	0.01
Fairbanks	Alaska	0.01	Helena	Mont.	0.03
Juneau	Alaska	0.01	Lincoln	Nebr.	0.01
Kodiak	Alaska	0.01	Concord	N. H.	—
Nome	Alaska	0.01	Trenton	N. J.	0.02
Point Barrow	Alaska	0.01	Santa Fe	N. Mex.	0.03
St. Paul Island	Alaska	0.01	Albany	N. Y.	0.03
Phoenix	Ariz.	0.01	Buffalo	N. Y.	0.01
Little Rock	Ark.	0.01	New York	N. Y.	—
Berkeley	Calif.	0.01	Gastonia	N. C.	0.02
Los Angeles	Calif.	0.02	Bismarck	N. D.	0.01
Denver	Colo.	0.02	Columbus	Ohio.	0.01
Dover	Del.	0.01	Painesville	Ohio.	0.01
Hartford	Conn.	0.01	Oklahoma City	Okla.	0.02
Washington	D. C.	0.02	Ponca City	Okla.	0.02
Jacksonville	Fla.	0.01	Portland	Oreg.	0.02
Miami	Fla.	0.01	Harrisburg	Pa.	0.01
Atlanta	Ga.	0.03	San Juan	P. R.	—
Agana	Guam	0.01	Providence	R. I.	0.02
Honolulu	Hawaii	0.02	Columbia	S. C.	0.02
Boise	Idaho	0.02	Pierre	S. D.	0.02
Springfield	Ill.	0.01	Nashville	Tenn.	0.01
Indianapolis	Ind.	0.02	Austin	Tex.	0.01
Iowa City	Iowa	0.01	El Paso	Tex.	0.02
Topeka	Kans.	0.02	Salt Lake City	Utah	0.02
Frankfort	Ky.	0.01	Richmond	Va.	0.01
New Orleans	La.	0.01	Barre	Vt.	0.02
Augusta	Maine	0.02	Seattle	Wash.	0.02
Presque Isle	Maine	0.02	Charleston	W. Va.	0.02
Baltimore	Md.	0.02	Madison	Wis.	0.01
Lawrence	Mass.	0.02	Cheyenne	Wyo.	0.02
Winchester	Mass.	0.01	Sundance	Wyo.	—
Lansing	Mich.	0.02			

[a] Dash indicates no data received.

Cesium–137 Levels In Man

Walter Reed Army Institute of Research, Washington, D.C., and
U.S. Army Medical Research Unit, Landstuhl, Germany

Whole body counting facilities at the Walter Reed Army Institute of Research (WRAIR), Washington, D. C., and the Medical Research Unit, Landstuhl, Germany, continue the program for measuring the levels of cesium–137 in people.

TABLE 1.—ASSAYS PERFORMED AT THE U. S. ARMY MEDICAL RESEARCH UNIT, LANDSTUHL, GERMANY

Date	Subjects residing in	Number of subjects	$\mu\mu c$ Cs^{137}/gm K (average)
December 1961	West Germany	109	34
January 1962	West Germany	73	33
February 1962	West Germany	299	28

TABLE 2.—ASSAYS PERFORMED AT THE WALTER REED ARMY INSTITUTE OF RESEARCH, FIRST QUARTER 1962

Geographic area	Number of subjects	$\mu\mu c$ Cs^{137}/gm K (average)
Europe	7	36
Far East	3	37
United States	104	28

This report presents results from Germany for the period December 1961 through February 1962, and from Walter Reed for the first quarter of 1962. The Landstuhl data are listed by month in table 1 and the Walter Reed data are listed by geographic area in tables 2 and 3. The data of tables 1 and 2 are summarized in table 4.

Previous coverage in *Radiological Health Data:*

Period	*Issue*
Third Quarter 1960	April 1961
Fourth Quarter 1960	April 1961
First Quarter 1961	July 1961
Second Quarter 1961	October 1961
Third Quarter 1961	January 1962
Fourth Quarter	April 1962

TABLE 3.—ASSAYS OF INDIVIDUALS RESIDING WITHIN THE UNITED STATES PERFORMED AT WRAIR, FIRST QUARTER, 1962

State	Number of subjects	$\mu\mu c$ Cs^{137}/gm K (average)
Alabama	1	23
Arizona	1	32
California	5	33
Colorado	2	77
District of Columbia	23	26
Georgia	3	23
Illinois	5	30
Kentucky	2	20
Massachusetts	2	11
Maryland	10	25
Michigan	2	34
Minnesota	1	12
North Carolina	3	19
New Jersey	5	31
New York	7	26
Ohio	7	26
Oklahoma	1	31
Pennsylvania	8	11
South Dakota	1	0
Texas	4	27
Utah	1	30
Virginia	5	34
Vermont	2	29
Washington	1	18
Wisconsin	1	12
West Virginia	1	14

TABLE 4.—SUMMARY OF TABLES 1 AND 2—FIRST QUARTER, 1962

Geographic area	Number of subjects	$\mu\mu c$ Cs^{137}/gm K (average)	Percent MCP[a]
Europe	7	36	0.18
Far East	3	37	0.19
United States	104	28	0.14
West Germany	481	[b] 31	0.16

[a] *Radiological Health Data,* 2: 193–4 (April 1961).
[b] Values represent determinations for December 1961 through February 1962.

Environmental Levels of Radioactivity at Atomic Energy Commission Installations

The U.S. Atomic Energy Commission receives from its contractors quarterly reports on the environmental levels of radioactivity in the vicinity of major Commission installations. The reports include data from routine monitoring programs where operations are of such a nature that plant perimeter surveys are required.

TABLE 1.—SELECTED ENVIRONMENTAL MPC VALUES PERTAINING TO AEC INSTALLATION REPORTS IN THIS SUBSECTION

Line no.	Radionuclide or mixture of radionuclides	Environmental MPC's	
		Water ($\mu\mu c$/liter)	Air ($\mu\mu c/m^3$)
1	If Sr^{90}, I^{129}, Pb^{210}, Po^{210}, Ra^{226}, Ra^{228}, Th^{230}, Pa^{231}, and Th-nat are not present[a]	2,000	—
2	If Sr^{90}, Pb^{210}, Ra^{226}, Ra^{228} are not present[a]	600	—
3	If Ra^{226}, Ra^{228} are not present[a]	100	—
4	Mixture of unidentified nuclides	10	0.04
5	If α emitters and Ac^{227} are not present[a]	—	1.0
6	If α emitters and Pb^{210}, Ac^{227}, Ra^{228}, and Pu^{241} are not present[a]	—	10
7	If α emitters and Sr^{90}, I^{129}, Pb^{210}, Ac^{227}, Ra^{228}, Pa^{231}, Pu^{241}, and Bk^{249} are not present[a]	—	100
	Iodine-131 ($\beta - \gamma$)	[b]2,000	300
	Iodine-133 ($\beta - \gamma$)	7,000	1,000
10	Iodine-135 ($\beta - \gamma$)	20,000	4,000
11	Thorium-234 ($\beta - \gamma$)	20,000	100
12	Uranium-natural ($\alpha - \gamma$)	20,000	2

[a] "Not present" implies the concentration of the nuclide is small compared with its appropriate MPC. According to recent FRC recommendations a group of nuclides may be considered not present if the ratio of each nuclide to its appropriate MPC is equal to or less than 1/10 and if the sum of these ratios for the group in question is equal to or less than 1/4.

[b] See FRC discussion on page 5-4.

Various summaries of the environmental radioactivity data for AEC installations have appeared in *Radiological Health Data* since November 1960. Summaries follow for Project Gnome, Atomics International (third and fourth quarters 1961), and Paducah Plant (third and fourth quarters 1961).

The measured concentration of a radionuclide in air and water may be compared with the Maximum Permissible Concentration (MPC) of that nuclide as recommended by the National Committee on Radiation Protection and Measurement (NCRP). For the environment near an AEC installation, the applicable MPC's are one-tenth of the occupational MPC values for continuous exposure given in National Bureau of Standards "Handbook 69." The MPC values applicable to the following reports are given in table 1.

The radiation protection guides for iodine-131 (Federal Radiation Council Report No. 2) indicate a concentration guide considerably lower (by a factor of 20) than the MPC for water given in table 1. Since the FRC's recommendation is based on the small thyroid of a young child, it may be implied that the MPC's for all iodine radio-isotopes should be reduced by the same factor.

In the following reports, nonspecific terms such as "total activity," "total alpha," and "gross beta" do not in themselves suggest any one MPC value. Often, when concentrations are low a laboratory will assign an MPC value that is more restrictive than necessary. This avoids the more costly isotopic tests necessary to justify a less restrictive value. References to table 1 will be made to designate the appropriate MPC's reported by the laboratory.

PROJECT GNOME

Plowshare Program, Atomic Energy Commission
Carlsbad, New Mexico

On December 10, 1961, an underground nuclear detonation took place near Carlsbad, New Mexico (Project Gnome), as a part of the Plowshare Program. The tunnel did not seal completely and some radioactivity escaped, principally in the form of gases. The activity was carried by the winds to the north northeast. The following summaries of environmental contamination are based on the PHS report, "Off-Site Radiological Safety Report (Project Gnome)."

External Gamma

Of 285 film badges placed on persons and at localities around the test site, only 6 recorded a radiation exposure. The film badge showing the highest reading (165 milliroentgens) was located out-of-doors at Hudson Farm about 21 miles northwest of ground zero. The highest reading on any of the film badges worn by persons was 140 milliroentgens (also at Hudson Farms).

At the International Minerals and Chemical Corporation mine (12 miles north northwest of ground zero) the estimated out-of-doors exposure based on automatic recording survey meters was about 8 milliroentgens. There were about 74 miners present at the time of the passage of the radioactive air mass. Although the edge of the radioactive air mass passed over Artesia, New Mexico (45 miles northwest of ground zero), none of the film badges showed any exposure. The minimum detectable exposure for this type of film badge is about 30 milliroentgens.

Mine Surveys

Eight mines located within a 30 mile radius from the Gnome site were monitored for external beta-gamma levels before and after the shot event. The two sets of readings remained essentially the same.

Air Sampling

Of the 20 air samplers in operation only a few filters showed any appreciable increase of gross beta activity with the highest reading 160 $\mu\mu c/m^3$ for the 16¾ hour sampling period. The highest concentrations of iodine–131, iodine–133 and iodine–135 were 1.7 $\mu\mu c/m^3$, 18 $\mu\mu c/m^3$, and 3.5 $\mu\mu c/m^3$, respectively. All of the above were for a 16 hour collection period at the International Minerals and Chemical Corporation mine. All of the concentrations were well below permissible levels for the general population.

Water Sampling

Fourteen water sampling points were selected in the vicinity of the Gnome event. The The Off-Site Radiological Safety Report stated "No significant difference in radioactivity was found between the pre- and post-detonation water samples collected. Because of the possibility that radioactivity may enter the underground water strata over a long period of time, periodic water samples will continue to be taken during 1962 to continue the water surveillance activities in this area."

Milk Sampling

Milk samples were taken from eight producer dairies in the vicinity of the Gnome site. No increase in radioactivity was detected in the milk supplies from the Gnome event.

Animal Sampling

Five cattle were slaughtered prior to the Gnome event and five more about a month after the detonation for radiochemical analyses of their body tissues and organs. All the radioactive concentrations were found to be comparable for pre- and post-shot samples with the exception of one animal collected post-shot that had 1,100 $\mu\mu c/gm$ iodine–131 in the thyroid, and 0.14 $\mu\mu c/gm$ of cesium–137 in the muscle and 1.2 $\mu\mu c/gm$ of cesium–137 in the liver.

Surface Contamination

Although the radioactvity released from the tunnel was largely gaseous in form there was some particulate fallout in the local area. Some vehicles passing along Highways 31 and 128 (about 9 miles from ground zero) were contaminated, with the highest readings being about 200 milliroentgens per hour around the radiator and 150 milliroentgens per hour around the tires at about one hour after shot time. The highest reading inside of the cars was 15 milliroentgens per hour. Seven cars were washed with the result that the highest reading was 15 milliroentgens per hour around the radiator and essentially equal to background inside the car. Two individuals were found to have slight amounts of contamination (one on the hand and one in the hair), i.e., less than one milliroentgen per hour (beta plus gamma).

ATOMICS INTERNATIONAL
Third and Fourth Quarters 1961

Canoga Park, California

The Nuclear Development Field Laboratory (NDFL) and the World Headquarters Facility (WHF) are operated for AEC by Atomics International (AI), Canoga Park, California. The locations of the two facilities are shown in figure 1.

The NDFL facilities include a 20 megawatt SRE power reactor; several smaller experimental reactor facilities such as critical facilities, SNAP reactor, shield test facilities, and others; and extensive rolling and fuel fabrication operations. The major activities at the WHF are of the administrative type. However, a small amount of fuel fabrication is conducted at the site. For that reason the WHF area is included in the Atomics International environmental monitoring program.

Air Monitoring

Environmental air sampling is conducted continuously at the WHF and NDFL sites by automatic 24-hour step cycle air monitors. Airborne particulates are collected on a fixed filter tape which is moved, after each twenty-four hour period, to place the new sample beneath a thin window G. M. detector. At pre-set intervals, usually 20 minutes, the number of counts, observed by the scaler during the interval, is recorded.

It has been determined that for this type of instrument twice the counting rate after 18.6 hours decay minus the counting rate after 8 hours decay closely approximates the long-lived contribution. This counting rate can be

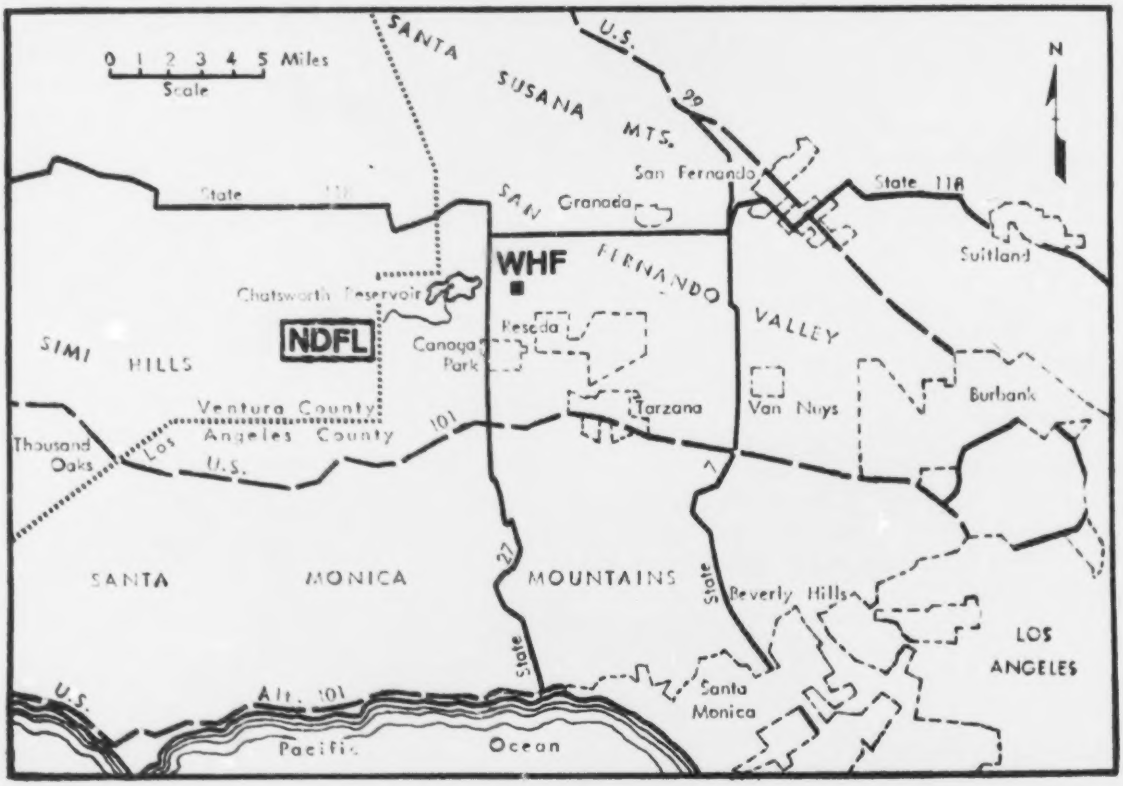

FIGURE 1.—ATOMICS INTERNATIONAL FACILITIES AND VICINITY

TABLE 2.—AVERAGE CONCENTRATIONS OF RADIOACTIVITY IN THE ENVIRONMENT AT THE ATOMICS INTERNATIONAL FACILITIES

Type of sample and minimum detection levels	Location	Type of analysis	Third quarter 1961		Fourth quarter 1961		Calendar year 1961	
			Number of samples	Average concentration	Number of samples	Average concentration	Number of samples	Average concentration
Air ($\beta-\gamma$ = 0.04 μμc/m^3)	WHF	$\beta-\gamma$	79	0.89	92	13	313	4.2
	NDFL	$\beta-\gamma$	79	0.89	55	10	176	3.6
Water (α = 0.05 μμc/liter) ($\beta-\gamma$ = 2.5 μμc/liter)	NDFL wells	α	6	0.13	6	0.06	24	0.08
		$\beta-\gamma$		<2.5		4.5		2.9
	Chatsworth Reservoir	α	15	0.47	13	0.63	43*	0.50*
		$\beta-\gamma$		6.0		19		11*
Soil (α = 0.24 μμc/gm) ($\beta-\gamma$ = 7 μμc/gm)	On-site	α	30	0.40	30	0.26	120	0.34
		$\beta-\gamma$		35.0		31		34
	Off-site	α	114	0.35	114	0.24	458	0.28
		$\beta-\gamma$		22.0		24		23
Vegetation (α = 0.08 μμc/gm ash) ($\beta-\gamma$ = 14 μμc/gm ash)	On-site	α	30	0.36	30	0.53	120	0.34
		$\beta-\gamma$		120		455		224
	Off-site	α	114	0.25	114	0.38	459	0.28
		$\beta-\gamma$		109		593		246

* Based on three quarters.

converted easily to the average long-lived airborne activity (μμc/m^3) during the sampling period. The minimum detection limit, which varies somewhat between instruments, is on the order of 0.04 μμc/m^3. The average concentrations of long-lived airborne beta emitters are shown in table 2.

When abnormally high activities are observed, the data are plotted to determine the presence of short-lived activities other than radon and thoron daughters. If fallout is suspected, samples are removed to the laboratory where their decay is observed for a period of several days to several weeks. If the activity decays as a function of $t^{-1.2}$, the data are extrapolated in order to find the date of origin. This date is then compared with the dates of announced nuclear detonations in order to demonstrate that the abnormal airborne activity was not caused by Atomics International operations.

Water Monitoring

Two water wells at the Nuclear Development Field Laboratory are sampled monthly. Monthly surface samples are collected at the Chatsworth Reservoir, owned by the Los Angeles City Department of Water and Power. The average water activity is shown in table 2.

Soil and Vegetation Sampling

Soil and vegetation are sampled monthly at 38 locations. Ten of these are within the boundaries of the Atomics International sites; the remaining 38 are within a ten-mile radius of the sites. Data for soil and vegetation are shown in table 2.

Surface soil types available for sampling range from decomposed granite to clay and sandy loam. Collected samples represent the top one-half inch layer of ground surface.

Vegetation samples obtained in the field at each station are of the same plant type wherever possible, and are generally sunflower or wild tobacco plant leaves. These plant types maintain an active rate of growth during the dry season, a characteristic uncommon to most other plant types indigenous to the area.

Previous coverage in *Radiological Health Data:*

Period	*Issue*
1960 and first and second quarters 1961	December 1961

PADUCAH PLANT
Third and Fourth Quarters 1961

Union Carbide Nuclear Company
Paducah, Kentucky

The Paducah Plant is a Government owned gaseous diffusion plant operated by Union Carbide Nuclear Company for the Atomic Energy Commission. The gaseous diffusion plant and the associated uranium hexafluoride manufacturing plant and uranium metal foundry process large quantities of relatively pure uranium compounds. The major sources of external penetrating radiation from such materials are the daughter-product isotopes of thorium and protactinium formed by alpha decay and subsequent beta decay of the parent uranium. These isotopes are concentrated in the ash produced during the fluorination process. The element uranium can be a physiological hazard only if it enters the body. The chemical toxicity of the uranium materials processed at the Paducah Plant overshadows any radiation danger from this element, making it a physiological risk comparable to lead, mercury, or other well-known heavy metals.

Uranium is a rather expensive material, and thus represents a great incentive to recover as much as is economically feasible. To protect the population and to maintain a wholesome relationship with neighboring communities and individuals, the air is exhausted through filters, and all effluent waters are discharged at extremely low concentrations of uranium.

Since no recovery process or filtering system is 100 percent efficient, an environmental monitoring program is used to evaluate the effectiveness of such measures. The Paducah Plant Environmental Monitoring Program consists

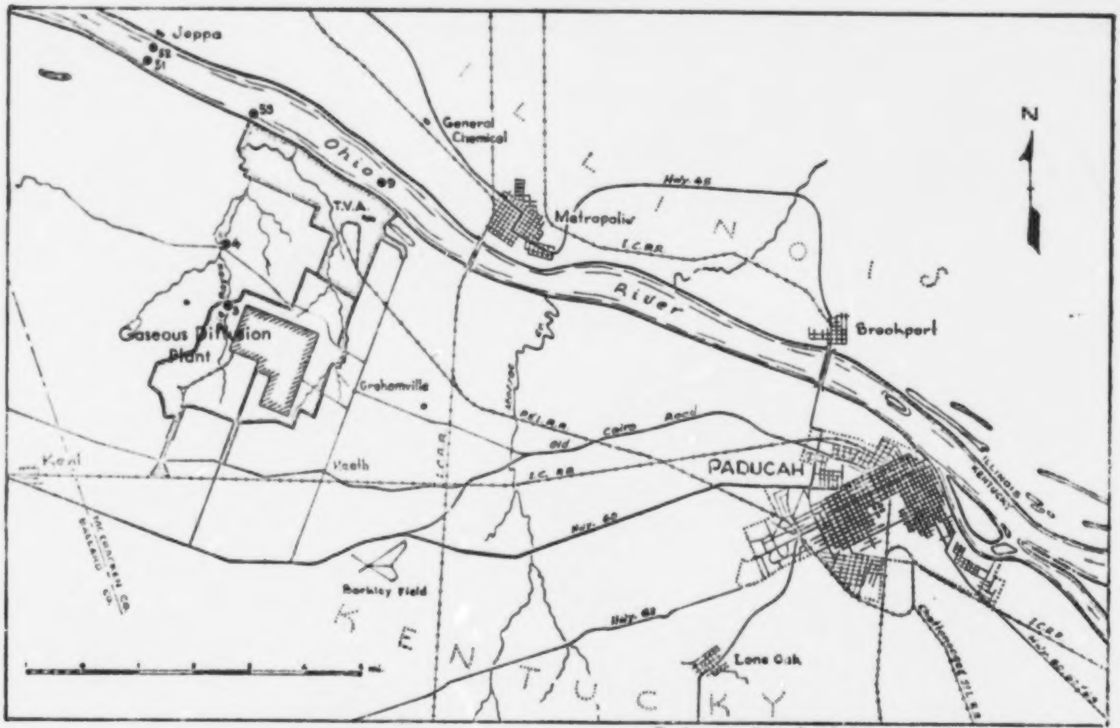

FIGURE 2.—WATER SAMPLING LOCATIONS, PADUCAH GASEOUS DIFFUSION PLANT

of a continuing system for sampling air in four stations around the plant perimeter fence, and four off-site stations; and for sampling water at two locations in Big Bayou Creek, and four locations on the Ohio River as shown in figures 2 and 3. Tables 3 and 4 present air and water monitoring data.

Previous coverage in *Radiological Health Data:*

Period	*Issue*
1959 and first quarter 1960	December 1960
Second and third quarters 1960	March 1961
Fourth quarter 1960	July 1961
First and second quarters 1961	January 1962

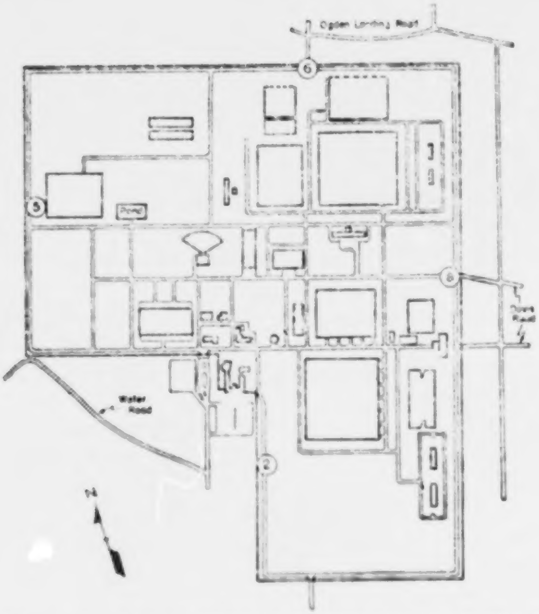

Figure 3.—AIR SAMPLING POSITIONS, PADUCAH GASEOUS DIFFUSION PLANT

Table 3.—RADIOACTIVITY IN THE PADUCAH PLANT ENVIRONMENT*

Sampling details		Third quarter 1961		Fourth quarter 1961		Calendar year 1961	
Type	Location & Frequency	Uranium	Beta	Uranium	Beta	Uranium	Beta
Air ($\mu\mu c/m^3$) Minimum detection level: U = 0.018 beta = 0.075	At plant perimeter:						
	North (No. 6) weekly	0.19	9.3	0.17	3.3	0.13	4.4
	East (No. 8) weekly	0.12	6.5	0.095	3.7	0.068	2.8
	South (No. 2) weekly	0.13	6.3	0.084	5.1	0.074	3.6
	West (No. 5) weekly	0.12	5.4	0.068	4.1	0.066	2.6
	Average	0.14	6.9	0.104	5.2	0.084	3.3
	One mile outside plant perimeter:						
	North weekly	0.10	3.4	0.092	3.6	0.072	2.2
	East weekly	0.12	3.5	0.068	6.9	0.060	2.3
	South weekly	0.12	5.0	0.097	4.2	0.073	3.2
	West weekly	0.12	3.5	0.084	6.0	0.073	2.4
	Average	0.12	3.8	0.085	4.0	0.072	2.5
Water ($\mu\mu c$/liter) Minimum detection level: U = 1 beta = 100	Big Bayou Creek:						
	No. 3 weekly	15	300	19	330	17	270
	No. 4 monthly	11	400	34	140	16	290
	Ohio River:						
	No. 9	<1	100	<1	180	<1	190
	No. 51	<1	100	1.3	<100	<1	160
	No. 52	1	100	<1	<100	<1	150
	No. 53	<1	300	<1	<100	<1	170

* For MPC values see table 1, lines 11 and 12.

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Survey of Radioactivity in Animal Feeds

Food and Drug Administration

A part of the continuing surveillance of radioactivity in foods by the Food and Drug Administration is concerned with the levels of strontium-90 in animal feeds. The samples are analyzed in a manner similar to food items, as indicated in Section II of this issue. Data on strontium-90 in animal foods appear in tables 1 and 2.

The leafy types of animal feeds show a higher concentration of strontium-90 than the other types. Alfalfa in particular demonstrates an increased strontium-90 concentration following resumption of U.S.S.R. nuclear testing. Also, alfalfa shows a higher strontium-90 concentration in the east zone than in the west harvest zone.*

Previous coverage in *Radiological Health Data:*

Period	*Issue*
1959	December 1960
1960	September 1961
1960 and 1961	December 1961
1960	April 1962

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* See figure 1 in food section.

TABLE 1.—STRONTIUM-90 CONTENT OF VARIOUS ANIMAL FOODS

Animal food	Pre-test			Post-test		
	No. of samples	Mean ($\mu\mu c$/kg)	Standard deviation of mean	No. of samples	Mean ($\mu\mu c$/kg)	Standard deviation of mean
Alfalfa:						
West	2	52.5	12.7	5	176	36.2
Central	3	137	63.5	1	303	—
East	—	—	—	2	354	0.00
Beet pulp:						
West	3	44.4	10.2	2	71.5	8.64
Central	2	87.5	39.4	1	76	—
East	—	—	—	—	—	—
Corn silage:						
West	—	—	—	—	—	—
Central	—	—	—	2	28.5	8.35
East	—	—	—	1	44	—
Cottonseed hull & seed:						
West	1	12	—	1	7.6	—
Central	1	3.1	—	—	—	—
East	2	42	5.91	—	—	—
Lespedeza:						
West	—	—	—	—	—	—
Central	—	—	—	—	—	—
East	3	394	90.0	2	658	241
Peanut hay:						
West	—	—	—	—	—	—
Central	—	—	—	—	—	—
East	—	—	—	2	727	102
Sorghum:						
West	—	—	—	2	41	5.46
Central	—	—	—	—	—	—
East	—	—	—	—	—	—
Sudan grass:						
West	—	—	—	—	—	—
Central	1	89	—	—	—	—
East	—	—	—	—	—	—

TABLE 2.—STRONTIUM-90 CONTENT OF VARIOUS ANIMAL FEEDS

Product	Origin			Harvest or collection date	Strontium-90 (μμc/kg)
	Harvest region	State or country	County		
Alfalfa	1	Calif.	San Bernardino	July 10, 1960	40
		Idaho	Jerome	Sept. 26, 1961	272*
			Jefferson	Oct. 26, 1961	207*
	2	Colo.	Larimer	Aug. 25, 1960	65
			Morgan	Nov. 9, 1961	161*
	3	Okla.	Kay	Aug. 7, 1960	18
			Choctaw	Aug. 23, 1961	234
	3	N. Mex.	Dona Ana	Sept. 22, 1961	52*
			San Juan	Sept. 25, 1961	189*
	5	Mich.	Lenawee	Aug. 10, 1961	158
	5	Wis.	St. Croix	Oct. 28, 1961	303*
	10	Va.	Bedford	Jan. 18, 1962	344*
	10	W. Va.	Jefferson	Jan. 5, 1962	365*
Beet Pulp	1	Calif.	Yolo	Aug. 17, 1961	24
	1	Idaho	Twin Falls	Oct. 9, 1961	61*
	2	Colo.	Logan	Feb. 9, 1961	54
			Weld	Oct. 9, 1961	82*
	2	Wyo.	Washakie	Jan. 18, 1961	55
	4	Minn.	Chippewa	Nov. 28, 1961	76*
	4	Nebr.	Buffalo	Oct. 17, 1960	127
	7	Ohio	Wood	Sept. 30, 1960	48
Corn silage	4	Minn.	Wright	Dec. 26, 1961	37*
	5	Wis.	Waupaca	Nov. 1, 1961	20*
	10	Va.	Roanoke	Feb. 14, 1962	44*
Cottonseed meal	1	Calif.	Tulare	Dec. 1, 1960	12
	3	N. Mex.	Chavez	Nov. 16, 1961	7.6*
	3	Tex.	Terry	Oct. 11, 1960	3.1
	9	S. C.	Bamberg	Sept. 15, 1960	36
Hull				Sept. 15, 1960	48
Lespedeza	9	N. C.	Wake	Jan. 17, 1961	447
				Jan. 24, 1962	809*
	10	Md.	Howard	Jan. 24, 1961	204
	10	Va.	Washington	Feb. 8, 1961	829
			Bedford	Jan. 18, 1962	417*
Peanut hay	10	Va.	Nansemond	Dec. 15, 1961	814*
			Dinwiddie	Feb. 6, 1962	629*
Sorghum	3	Ariz.	Yuma	Oct. 24, 1961	46*
	3	N. Mex.	Quay	Dec. 14, 1961	35*
Sudan grass	3	Okla.	Comanche	Aug. 23, 1961	89

* Denotes products harvested after September 15, 1961.

Reported Nuclear Detonations

July 1962

Since October 1961, summary information on all known nuclear detonations during the month preceding publication have been regularly reported in this section. The table below summarizes the tests conducted during July 1962.

Test number	Location	Date	Yield range*	Type of test
67	Nevada Test Site	July 6	1000 kiloton	Underground (peaceful application).
68	Nevada Test Site	July 7	Low	Slightly aboveground.
69	Johnston Island	July 9	Megaton	Atmospheric (high altitude).
70	Christmas Island	July 10	Intermediate	Atmospheric.
71	Nevada Test Site	July 11	Low	Underground (shallow depth).
72	Christmas Island	July 11	Low megaton	Atmospheric.
73	Nevada Test Site	July 13	Low	Underground.
74	Nevada Test Site	July 14	Low	Atmospheric.
75	Nevada Test Site	July 17	Low	Atmospheric.
76	Nevada Test Site	July 27	Low	Underground.

* Low yield range has been announced as meaning about a nominal (20 kiloton) yield; intermediate yield meaning the range between nominal and one megaton; and low megaton meaning more than one but less than 5 megatons.

RADIOLOGICAL HEALTH DATA

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SEPTEMBER 1962

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U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service • Division of Radiological Health

SPECIAL REPORT

Additional clarifying statements have recently been issued on the interpretation of the Federal Radiation Council's Radiation Protection Guides when environmental radiation levels increase due to nuclear weapons testing fallout. This information has developed from a recent exchange of letters between the Joint Committee on Atomic Energy (JCAE) and the Federal Radiation Council (FRC).

In a letter dated June 18, 1962, to the FRC from Congressman Chet Holifield, Chairman JCAE, and Congressman Melvin Price, Chairman, Subcommittee on Research, Development, and Radiation, JCAE, information was requested in three questions relating to the interpretation of the Radiation Protection Guides.

The complete text of the JCAE questions (italicized) and answers from the FRC are contained in the following letter, dated August 17, 1962, signed by the FRC Chairman, Anthony J. Celebrezze:

FEDERAL RADIATION COUNCIL
Executive Office Building
Washington 25, D.C.

August 17, 1962

Dear Mr. Chairmen:

Your letter of June 18, 1962, points out that following the recent hearings of the Subcommittee on Research, Development and Radiation of the Joint Committee on Atomic Energy, there were unresolved questions concerning the application of radiation protection standards. Following the questions are comments of the Council.

No. 1: Are the numerical values of the Radiation Protection Guides established by the Federal Radiation Council the sole or principal criteria now used in evaluating when undesirable levels of radioactive nuclides from fallout have been reached?

No. 2: If so, is this use of the present numerical values of the Guides sufficient to indicate when and what action is appropriate to protect public health?

Comments on First Two Questions: No, the Guides are not the sole criteria used in evaluating the significance of fallout.

Since there has been widespread misunderstanding concerning these Guides, it may be useful to explain how they were developed and how they are to be used.

As you know, to be prudent we assume that there is always some slight risk to health from any level of radiation exposure, however low. Hence, setting basic radiation protection guidance involves a balancing between the requirements of total health protection (which, ideally, would tolerate no exposure) and the promotion of the use of radiation and atomic energy to achieve worthwhile benefits (which may involve exposure). With this principle in mind, the Guides were originally developed for application as guidelines for the protection of radiation workers and the general public against exposures which might result during "normal peacetime operations" in connection with the industrial use of ionizing radiation. In this connection, as noted in Chairman Ribicoff's letter of June 1 to you transmitting "Comments on the Major Unresolved Questions Concerning the Federal Radiation Council" the term "normal peacetime operations" referred specifically to the peaceful applications of nuclear technology where the primary control is placed on the design and use of the source. Since the numerical values in the Guides were designed for the regulation of a continuing industry, they were of necessity set so low that the upper limit of Range II can be considered to fall well within levels of exposure acceptable for a lifetime. Furthermore, to provide the maximum margin of safety, the upper limits of Range II were related to the lowest possible level at which it was believed that nuclear industrial technology could be developed.

It is necessary to watch the build-up of exposure levels as radiation exposures occur. A one year cumulative total has been recommended for this purpose. Obviously, this one-year span is an arbitrary measure, and no special significance should be attached to the precise cumulative exposure at the end of a 365 day period. Far more relevant are the sources of the exposure, their frequency and their likelihood of continuing.

The Guides are not intended to be a dividing line between safety and danger in actual radiation situations. Nor are they intended to set a line at which protective action should be taken or to indicate what kind of action should be taken. Some actions might in some circumstances be appropriate at levels below the Guides. Other actions might be completely inappropriate and even harmful except at levels many times above the Guide levels.

While the Guides were not specifically designed for fallout situations, they have some relevance for the assessment of fallout conditions. There is, of course, an essential difference between environmental radioactivity resulting from a long-term or permanent industrial operation and that related to intermittent production from individual weapons tests or series of weapons tests. With the former, it is predictable that introduction of radioisotopes into the environment will persist at a known rate throughout the life of the source. On the other hand, weapons tests are likely to be sporadic in nature and the radioactivity produced will rise at the time of testing and decline at varying rates for different isotopes after conclusion of a test or series of tests. While "normal peacetime operations," for which the Guides were recommended as appropriate, imply that environmental radioactivity will persist at a predetermined level throughout the human lifetime, that from fallout is likely to be extremely variable.

As applied to fallout, the Guides can be used as an indication of when there is a need for detailed evaluation of possible exposure hazards and a need to consider whether any protective action should be taken under all the relevant circumstances.

But once we are alerted to the need to consider protective action, the Guides do not tell us when to act or what to do. These judgments require careful consideration of local conditions and the impact of available health protection measures. The Council believes that individual fallout situations require individual evaluation before specific action is taken. Such an evaluation must involve a careful examination of the source and magnitude and duration of the probable exposure levels as well as a careful evaluation of the health significance of these probable exposures, and national security considerations are inevitably involved. The judgment as to when to take action and what kind of action to take to decrease exposure levels involves consideration of all of these factors. The Guides have some relevance for making this judgment, but they do not and were never intended to provide the sole basis for deciding how and when to act. It must be kept in mind that radiation exposures anywhere near the Guides involve risks so slight that countermeasures which themselves involve any slight hazard may have a net adverse rather than favorable effect on the public well-being.

In summary then, the Guides are not intended to be a dividing line between safety and danger. We have assumed that there is some slight risk to health from any level of radiation exposure, however low, even at or below the low levels set by the Guides. At the same time we do not believe there is any risk of a major health hazard until exposure levels are many times above the Guide levels' For example, this is borne out in relation to iodine-131 by the report to the Federal Radiation Council of the National Academy of Sciences, "Pathological Effects of Thyroid Irradiation," July 1962.

No. 3: If not, is the development of further or supplementary criteria needed and if so is it the responsibility of the Federal Radiation Council or the Public Health Service or others to develop and implement such criteria?

Comment: There is a continuing need for the development of guidance in this field. In accordance with Public Law 86-373, "The Council shall advise the President with respect to radiation matters, directly or indirectly affecting health, including guidance for all Federal agencies in the formulation of radiation standards and in the establishment and execution of programs of cooperation with States." The appropriate Federal agencies will develop specific modes of action in accordance with such guidance.

Your letter of June 18 mentioned another important matter left open after the hearings, that of the legal responsibility and authority for invoking countermeasures.

Within the Federal Government, authority now exists under the Federal Food, Drug, and Cosmetic Act to control the shipment of adulterated food in interstate commerce. By definition, foodstuffs containing excessive radioactivity would be adulterated.

States have the authority to control intrastate distribution or sale of adulterated foods, which would include foodstuffs containing excessive amounts of radioactivity. State food and drug laws vary widely in their scope and adequacy with respect to the problem of radioactivity in foods. The Public Health Service has the general responsibility to recommend appropriate health protection measures to States and local authorities and to the general public.

In closing, on behalf of the Council, I should like to acknowledge the Joint Committee's responsibile efforts to delineate problems relating to fallout requiring further study and clarification, and in promoting more widespread public understanding of the issues involved.

Sincerely yours,

[s] Anthony J. Celebrezze
Anthony J. Celebrezze
Chairman

The Honorable Chet Holifield
Chairman, Joint Committee on
Atomic Energy
Congress of the United States
Washington 25, D.C.

The Honorable Melvin Price
Chairman, Subcommittee on Research,
Development and Radiation

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SECTION I.—AIR AND PRECIPITATION

Fission Product Beta Activity in Airborne Particulates and Precipitation

Measurements of gross beta activity of airborne particulates and precipitation are among the earliest and most sensitive indicators of increases of fission product activity in the environment. However, a direct evaluation of biological effects is not possible from these data alone.

Of the several networks or sampling programs making such measurements, the Radiation Surveillance Network, the Naval Research Laboratory, and the Canadian Radioactive Fallout Study Program are represented in the following reports.

RADIATION SURVEILLANCE NETWORK
June 1962

Division of Radiological Health, Public Health Service

The Public Health Service Radiation Surveillance Network (RSN) was established in 1956 in cooperation with the Atomic Energy Commission primarily to provide a means of promptly determining increasing levels of radioactivity in air and precipitation due to fallout from nuclear weapons tests. Prior to September 1961, the Network consisted of 45 stations. Following the September 1961 resumption of nuclear weapons testing by the U.S.S.R., the Network has been expanded over a period of several months to 72 stations, whose locations are shown in figure 1.

Air

Daily 24-hour air samples are collected by a high volume air sampler with a 4-inch diameter carbon-loaded cellulose dust filter. Field measurements with a portable survey meter enable the station operator to estimate the amount of beta activity in airborne particulates at the station 5 hours after collection by comparison with a known Sr^{90}-Y^{90} source. This 5-hour delay eliminates interference from naturally-occurring radon daughters. Each operator then reports his field estimate by telephone to the Radiation Surveillance Center, Division of Radiological Health in Washington, D. C., to provide a daily national report.

The filters are then forwarded to the Radiation Surveillance Network Laboratory in Rockville, Maryland, for a more refined measurement using a thin-window gas-flow proportional counter. Each filter is counted at least 3 days after the end of the sampling period and re-counted 7 days later. The initial 3-day aging of the sample eliminates interference from naturally-occurring radon and thoron daughters. The 2 counts, separated by a 7-day interval, make possible the estimation of the age of fission products and extrapolation of the activity to the time of collection. The extrapola-

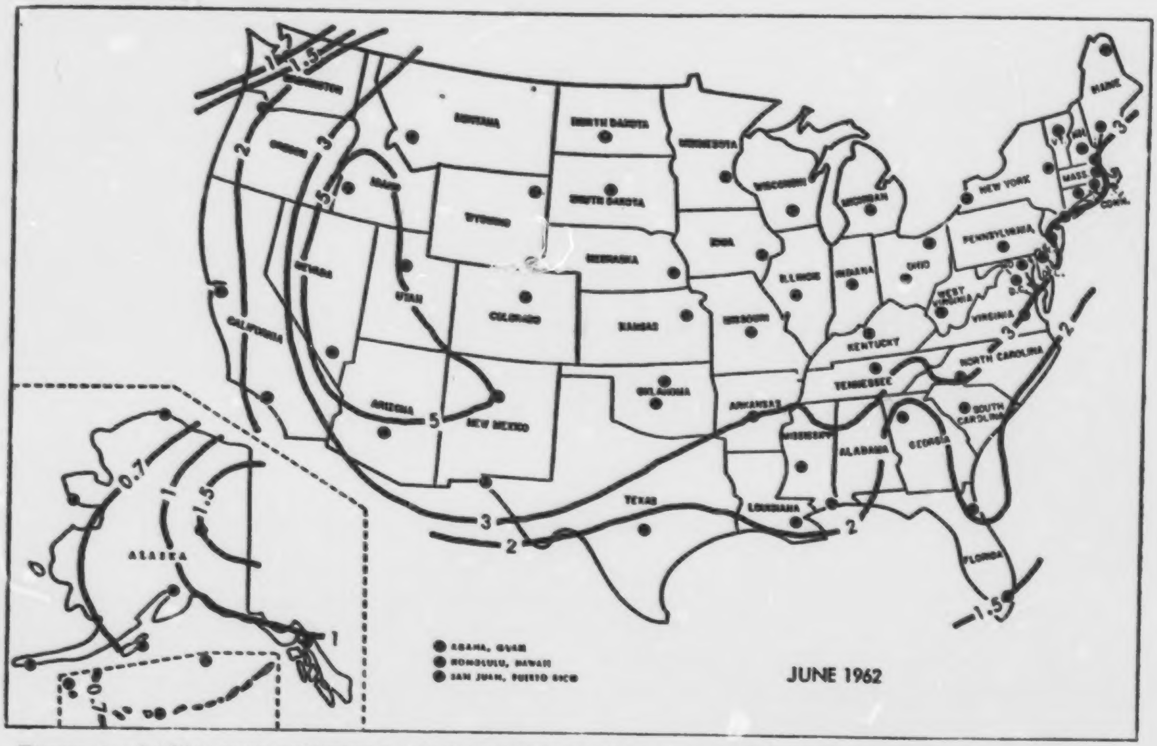

FIGURE 1.—RADIATION SURVEILLANCE NETWORK SAMPLING STATIONS AND AVERAGE FISSION PRODUCT CONCENTRATIONS IN AIR ($\mu\mu c/m^3$).

tion is performed by using the Way-Wigner formula ($AT^{1.2} = \text{constant}$).*

Although gross beta concentration is usually presented without reference to age, it is apparent that fission product activity is more adequately described when the age parameter is also given. An example of the interpretative usefulness of age of fission product data is presented in "Mid-May Iodine-131 in Fallout in the Midwest" in Section V of this issue. Because of the difficulty in determining a meaningful monthly average of age of fission products, such data have not yet been presented with the RSN data in *RHD*.

The average fission-product beta concentrations in surface air during June 1962 as determined by laboratory analysis are tabulated in table 1 and presented by means of iso-concentration contours in figure 1. Experience has shown that field estimates are generally comparable to laboratory analyses, except at low levels, where the former are usually higher because of natural thoron daughters.

Precipitation

Continuous sampling for total precipitation is conducted at most stations on a daily basis using funnels having collection areas of 0.4 square meter. A 500 ml aliquot of the collected precipitation is evaporated to dryness, and the residue is forwarded to the laboratory to be counted by the same method used for analyzing the air samples. If the collected sample is between 200 and 500 ml, the entire sample is evaporated; if less than 200 ml, (0.5 mm. rainfall equivalent for 0.5 square meter funnel) the volume of precipitation is reported, but no analysis is made.

The June 1962 averages of gross beta activity in precipitation, expressed in micromicrocuries per liter ($\mu\mu c$/liter) and micromicrocuries per

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* In this expression, A is the activity at time T after fission product formation. Units are arbitrary.

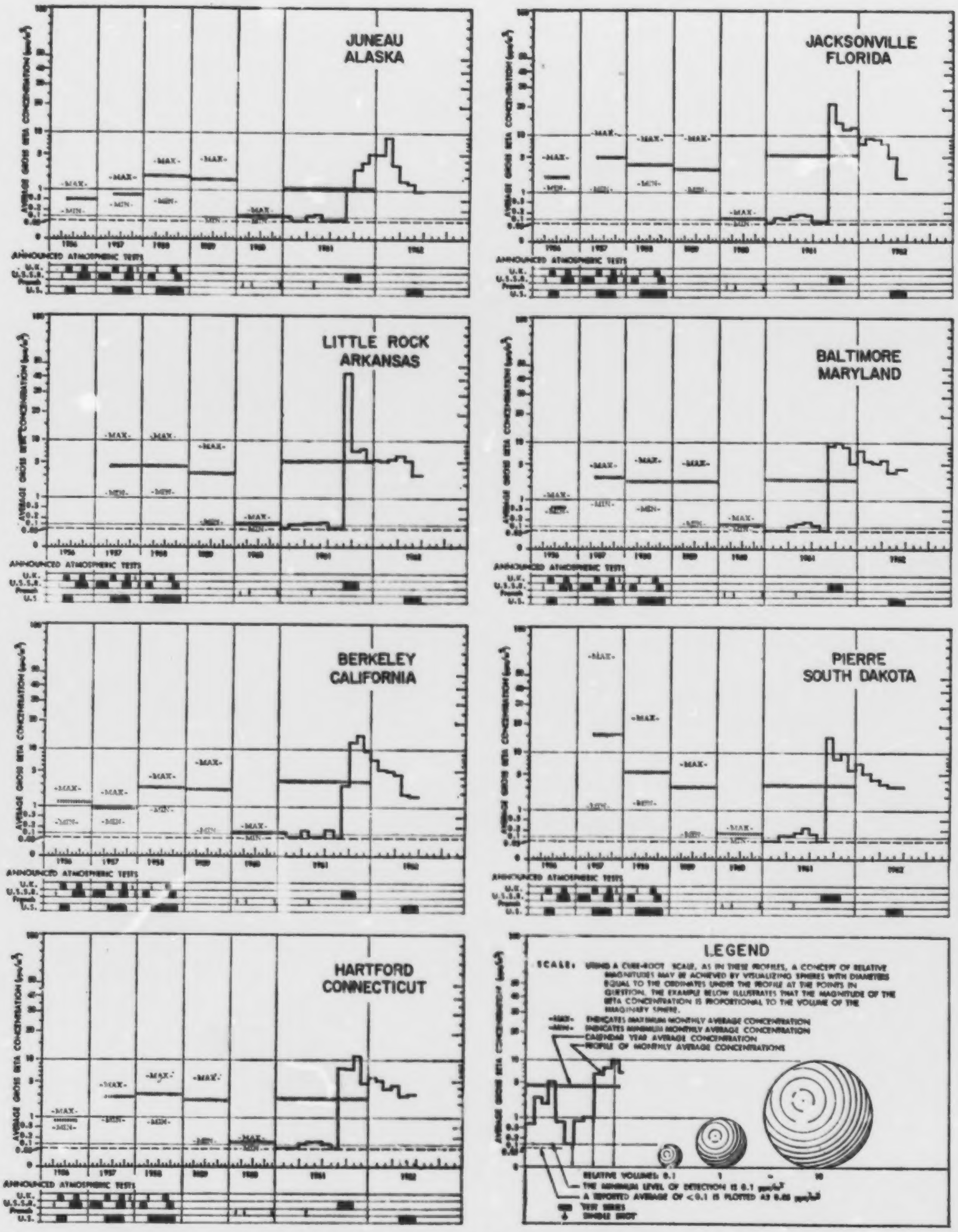

FIGURE 2.—PROFILES OF MONTHLY AND YEARLY AVERAGE FISSION PRODUCT BETA ACTIVITY IN AIRBORNE PARTICULATES FOR SEVEN STATIONS, 1956—JUNE 1962

TABLE 1.—GROSS BETA ACTIVITY OF PARTICULATES IN AIR, RSN, JUNE 1962

Concentrations in $\mu\mu c/m^3$

Station location		Number	Maximum	Minimum	Average*	Station location		Number samples	Maximum	Minimum	Average*
City	State					City	State				
Adak	Alaska	30	2.7	<0.10	0.66	Minneapolis	Minn	29	7.3	0.21	3.0
Anchorage	Alaska	30	2.9	<0.10	0.98	Jackson	Miss	29	7.2	0.64	2.4
Attu	Alaska	30	3.2	<0.10	0.74	Pascagoula	Miss	19	6.4	0.86	2.5
Fairbanks	Alaska	19	3.4	0.23	1.5	Jefferson City	Mo	30	7.3	0.79	3.2
Juneau	Alaska	21	1.8	<0.10	0.98	Helena	Mont	30	9.9	0.58	4.1
Kodiak	Alaska	26	2.8	<0.10	0.90	Lincoln	Nebr	27	7.9	0.66	4.2
Nome	Alaska	26	2.6	<0.10	0.67	Las Vegas	Nev	22	12	2.4	6.0
Point Barrow	Alaska	24	1.9	<0.10	0.58	Concord	N. H	16	8.6	1.3	3.9
St Paul Island	Alaska	30	2.3	<0.10	0.50	Trenton	N. J	30	4.8	0.60	2.8
Phoenix	Ariz	29	13	1.9	4.8	Santa Fe	N. Mex	28	12	2.5	5.0
Little Rock	Ark	30	8.9	0.65	3.0	Albany	N. Y	29	7.0	0.47	4.0
Berkeley	Calif	30	5.7	0.42	1.9	Buffalo	N. Y	30	12	0.56	4.6
Los Angeles	Calif	25	5.4	1.7	2.7	New York	N. Y	17	3.7	0.94	2.5
Denver	Colo	28	8.7	1.3	4.4	Gastonia	N. C	30	6.1	0.75	3.3
Hartford	Conn	30	5.7	0.68	3.1	Bismark	N. Dak	29	6.0	1.3	3.6
Dover	Del	20	7.9	0.21	3.9	Columbus	Ohio	30	6.8	1.2	4.3
Washington	D. C	30	7.7	0.26	3.4	Painesville	Ohio	30	6.4	0.18	3.7
Jacksonville	Fla	30	5.5	0.84	2.2	Oklahoma City	Okla	30	8.6	0.49	3.5
Miami	Fla	32	4.2	0.33	1.5	Ponca City	Okla	30	3.2	<.10	1.6
Atlanta	Ga	36	3.8	0.50	1.9	Portland	Oreg	29	3.6	0.50	2.1
Agana	Guam	20	3.5	0.51	1.3	Harrisburg	Pa	26	17	0.42	4.6
Honolulu	Hawaii	29	3.6	0.39	1.4	San Juan	P. R	—	—	--	—
Boise	Idaho	30	10	2.4	6.5	Providence	R. I	30	6.3	0.81	3.3
Springfield	Ill	29	10	0.77	3.8	Columbia	S. C	29	4.9	0.86	2.5
Indianapolis	Ind	30	10	0.72	3.9	Pierre	S. Dak	30	5.2	0.92	3.3
Iowa City	Iowa	30	34	0.16	3.9	Nashville	Tenn	27	7.7	1.2	3.8
Topeka	Kans	31	7.8	0.36	3.3	Austin	Tex	28	5.4	0.29	1.9
Frankfort	Ky	28	8.5	1.2	3.3	El Paso	Tex	29	9.6	1.4	3.7
New Orleans	La	29	8.7	0.34	2.1	Salt Lake City	Utah	25	8.3	2.4	4.7
Augusta	Maine	30	6.2	0.31	3.3	Barre	Vt	30	8.2	0.63	4.7
Presque Isle	Maine	30	6.9	<0.10	3.3	Richmond	Va	29	5.5	0.19	2.5
Baltimore	Md	30	10	0.37	4.5	Seattle	Wash	30	1.9	0.34	1.0
Rockville	Md	14	8.6	0.34	5.4	Charleston	W. Va	30	7.5	1.2	3.6
Lawrence	Mass	30	5.7	0.78	2.8	Madison	Wis	30	7.5	0.29	3.8
Winchester	Mass	29	5.5	0.81	2.9	Cheyenne	Wyo	30	7.7	1.5	4.0
Lansing	Mich	30	13	0.48	4.6	Network average					3.1

* Weighted average obtained by summing the products of individual sampling times and the corresponding activities and dividing by the summation of the individual sampling times.

TABLE 2.—GROSS BETA ACTIVITY IN PRECIPITATION, RSN, JUNE 1962

Station location		Average concentration ($\mu\mu c$/liter)	Total Deposition ($\mu\mu c/m^2$)	Station location		Average concentration ($\mu\mu c$/liter)	Total Deposition ($\mu\mu c/m^2$)
City	State			City	State		
Adak	Alaska	*	*	Minneapolis	Minn	1,100	58,000
Anchorage	Alaska	460	42,000	Jackson	Miss	700	14,000
Attu	Alaska	*	*	Pascagoula	Miss	480	54,000
Fairbanks	Alaska	*	*	Jefferson City	Mo	1,900	190,000
Juneau	Alaska	500	65,000	Helena	Mont	2,800	52,000
Kodiak	Alaska	*	*	Lincoln	Nebr	1,200	78,000
Nome	Alaska	*	*	Las Vegas	Nev	*	*
Point Barrow	Alaska	*	*	Concord	N H	*	*
St Paul Island	Alaska	*	*	Trenton	N J	690	2,300
Phoenix	Ariz	*	*	Santa Fe	N Mex	1,100	12,000
Little Rock	Ark	530	90,000	Albany	N Y	640	29,000
Berkeley	Calif	*	*	Buffalo	N Y	1,100	79,000
Los Angeles	Calif	*	*	New York	N Y	*	*
Denver	Colo	2,700	64,000	Gastonia	N C	420	79,000
Hartford	Conn	780	69,000	Bismark	N Dak	1,000	77,000
Dover	Del	*	*	Columbus	Ohio	880	45,000
Washington	D. C	830	120,000	Painesville	Ohio	4,400	430,000
Jacksonville	Fla	1,700	170,000	Oklahoma City	Okla	300	41,000
Miami	Fla	390	110,000	Ponca City	Okla	800	110,000
Atlanta	Ga	380	11,000	Portland	Oreg	380	4,900
Agana	Guam	*	*	Harrisburg	Pa	980	42,000
Honolulu	Hawaii	*	*	San Juan	P R	*	*
Boise	Idaho	3,400	4,200	Providence	R I	1,600	180,000
Springfield	Ill	<350	<3,500	Columbia	S C	630	88,000
Indianapolis	Ind	4,200	35,000	Pierre	S Dak	1,600	200,000
Iowa City	Iowa	680	34,000	Nashville	Tenn	420	53,000
Topeka	Kans	5,800	540,000	Austin	Tex	790	120,000
Frankfort	Ky	770	51,000	El Paso	Tex	*	*
New Orleans	La	690	170,000	Salt Lake City	Utah	1,500	33,000
Augusta	Maine	2,800	110,000	Barre	Vt	2,300	68,000
Presque Isle	Maine	710	51,000	Richmond	Va	1,800	150,000
Baltimore	Md	1,200	75,000	Seattle	Wash	2,200	15,000
Rockville	Md	*	*	Charleston	W Va	850	80,000
Lawrence	Mass	1,300	62,000	Madison	Wis	6,000	220,000
Winchester	Mass	1,100	83,000	Cheyenne	Wyo	1,200	81,000
Lansing	Mich	1,000	61,000				

* No evaporated sample received.

square meter ($\mu\mu c/m^2$) are presented in table 2. Placement of a "less than" sign (<) with an average concentration or total deposition value indicates that the sum of the "less than" daily deposition values is 10 percent or more of the total deposition so that the true total or average is considered significantly less than the value shown.

Profiles

The profiles of the monthly average fission product beta activity in airborne particulates for each RSN station covering the period of time from the formation of the network in 1956 to the end of 1960 were published in *RHD*, July 1961. The profiles of 7 stations, updated through June 1962, are shown in figure 2.

THE 80TH MERIDIAN (WEST) SAMPLING PROGRAM
May 1962

U. S. Naval Research Laboratory

Radioactivity measurements of surface air samples collected at various sites near the 80th Meridian (West) have been made since 1956. Sampling locations are shown in figure 3. This program is operated by the U. S. Naval Research Laboratory (NRL) with the cooperation of interested agencies of the United States, Canada, Ecuador, Peru, Bolivia, and Chile, which collect the samples and forward them to NRL for analysis. Partial financial support of this program is provided by the Division of Biology and Medicine, U. S. Atomic Energy Commission.

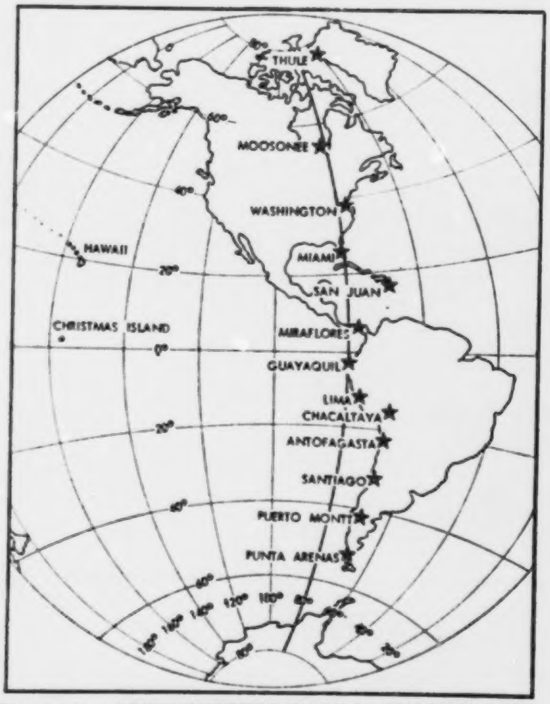

FIGURE 3.—ATMOSPHERIC RADIOACTIVITY SAMPLING STATIONS NEAR THE 80TH MERIDIAN (WEST)

The sampling procedure involves drawing air continuously for a seven-day period, at a rate of approximately 1200 cubic meters per day through a high efficiency filter, 8 inches in diameter, using a positive displacement blower. After the 7-day period, the filter is removed and forwarded to NRL for assay of gross beta activity. A minimum of 2 weeks after collection is allowed for decay of short-lived radionuclides. Data are not extrapolated to time of collection.

Analysis of the samples collected during May 1962 indicates the arrival of fresh debris from the Christmas Island tests at Lima, Chacaltaya, Antofagasta and Santiago. The distribution of activity closely parallels that observed in July 1958 during the U. S. Hardtack series in the Pacific, when activity first appeared and in highest concentrations at the high altitude sites. The levels of gross β-activity are currently such that in the Northern Hemisphere, as a result of the Fall 1961 U.S.S.R. test series, the influx of fresh debris from the Christmas Island area has not been apparent.

TABLE 3.—FISSION PRODUCT GROSS BETA ACTIVITY IN SURFACE AIR, NRL[1], MAY 1962

[Average concentrations in $\mu\mu c/m^3$]

Day	Punta Arenas, Chile	Puerto Montt, Chile	Santiago, Chile	Antofagasta, Chile	Chacaltaya, Bolivia	Lima, Peru	Guayaquil, Ecuador[2]	Miraflores, Panama Canal Zone	San Juan, P.R.	Mauna Loa, Hawaii[3]	Miami, Florida	Washington, D.C.	Moosonee, Ontario, Canada	Thule, Greenland
1														2.27
2 3 4 5 6 7	0.013	0.025	[4] —	0.056	0.056	0.096	—	2.41	—	4.55	8.32	6.26	3.52	1.43
8 9 10 11 12 13 14	0.018	0.027	0.076	1.35	3.52	3.58	—	2.54	—	5.85	9.09	7.16	7.16	3.34
15 16 17 18 19 20 21	—	0.024	0.537	2.18	6.76	1.62	—	1.27	—	4.48	8.78	6.48	3.72	2.59
22 23 24 25 26 27 28	0.017	0.076	0.125	3.14	9.12	7.11	—	1.47	4.95	5.76	6.44	5.90	6.53	2.22
29 30 31	0.018	0.021	0.159	1.68	4.22	2.90	-	1.00	0.81	3.48	2.64	4.77	3.03	5.31
Weighted average	0.016	0.036	0.233	1.68	4.90	3.08	—	1.83	3.70	5.00	7.61	6.30	5.08	2.54

[1] The average concentration determined from a given sample is placed at the center of a rectangle which indicates the length and dates of the sampling period. Station averages for the month were determined by weighting the sample average according to the number of days in the sampling period of that portion of the sampling period occurring in May 1962.

[2] Motor failure.

[3] Mauna Loa data have been included for comparison with Chacaltaya, Bolivia. Both are high elevation stations (3400 and 5200 meters) and about equally distant north and south of the equator.

[4] Dash indicates samples were not received.

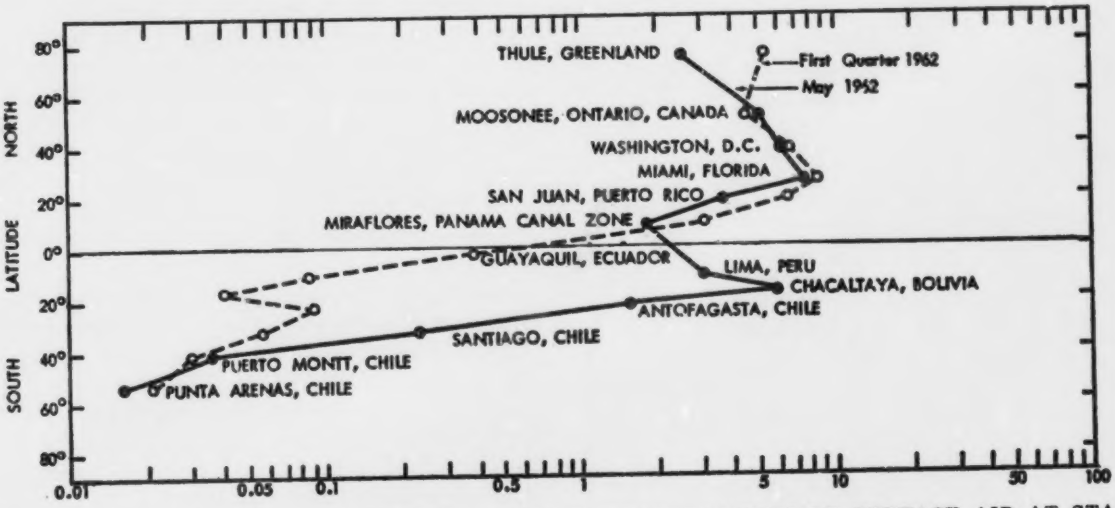

FIGURE 4.—PROFILE OF BETA ACTIVITY, AVERAGE MEASUREMENTS OF SURFACE AIR AT STATIONS NEAR THE 80TH MERIDIAN (WEST)—MAY 1962

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CANADIAN RADIOACTIVE FALLOUT STUDY PROGRAM
Fourth Quarter 1961

Department of National Health and Welfare, Ottawa, Canada

As part of its Radioactive Fallout Study Program (RFSP), the Radiation Protection Division, Department of National Health and Welware, Dominion of Canada, conducts air and precipitation sampling programs. The 24 air and precipitation stations are located at airports, and the equipment is operated by meteorologists of the Meterological Services Branch of the Department of Transport.

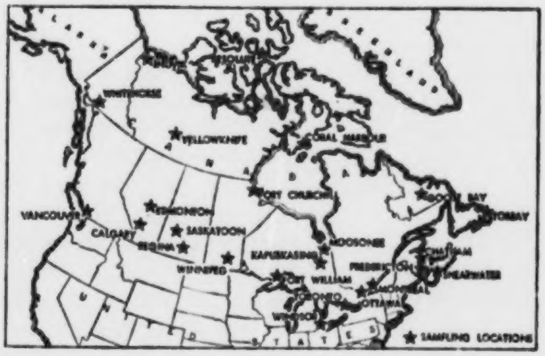

FIGURE 5.—CANADIAN AIR AND PRECIPITATION SAMPLING STATIONS

TABLE 4.—FISSION PRODUCT GROSS BETA ACTIVITY IN SURFACE AIR, RFSP, FOURTH QUARTER 1961

[Average concentration in $\mu\mu c/m^3$]

Station location	October	November	December	Station location	October	November	December
Calgary	20.5	27.2	10.3	Resolute	9.26	6.62	8.45
Chatham	16.0	17.8	7.70	Saskatoon	15.9	19.8	9.76
Coral Harbour	5.31	8.55	9.50	Shearwater	15.6	17.5	10.2
Edmonton	18.8	20.9	10.2	Torbay	14.2	17.2	7.15
Ft. Churchill	8.90	6.62	6.61	Toronto	23.2	20.0	10.0
Ft. William	18.7	17.3	10.8	Vancouver	12.1	21.7	8.50
Fredericton	15.2	16.0	8.25	Whitehorse	10.4	15.8	10.4
Goose Bay	7.92	10.2	6.80	Windsor	24.1	25.1	12.9
Inuvik	7.25	8.64	8.36	Winnipeg	24.8	15.1	10.7
Kapuskasing	16.2	22.0	7.29	Yellowknife	10.0	8.32	7.65
Montreal	20.4	16.9	10.4				
Moosonee	21.7	12.8	8.28	Maximum station avg	24.8	27.2	12.9
Ottawa	23.0	18.6	9.54	Minimum station avg	5.31	6.62	6.80
Regina	17.7	17.6	9.85	Overall average	15.7	16.2	9.15

TABLE 5.—FISSION PRODUCT GROSS BETA ACTIVITY IN PRECIPITATION, RFSP, FOURTH QUARTER

Station location	October		November		December	
	Concentration ($\mu\mu c$/liter)	Deposition ($\mu\mu c/m^2$)	Concentration ($\mu\mu c$/liter)	Deposition ($\mu\mu c/m^2$)	Concentration ($\mu\mu c$/liter)	Deposition ($\mu\mu c/m^2$)
Calgary	909.0	20,300	919.6	14,200	1843.7	22,900
Chatham	460.6	41,200	1126.3	90,100	1062.5	73,900
Coral Harbour	1199.2	25,000	2073.3	21,600	1298.0	32,000
Edmonton	2454.8	61,100	3071.9	51,500	2571.9	52,200
Fredericton	527.4	81,400	1441.0	118,600	930.2	104,700
Ft. Churchill	[a]—	—	817.7	72,600	1334.6	38,000
Ft. William	1880.2	107,500	1783.0	63,400	1586.9	44,300
Goose Bay	339.0	42,900	755.4	40,100	861.8	41,400
Inuvik	820.8	29,000	2203.9	54,300	2010.9	27,100
Kapuskasing	1807.3	120,700	725.0	49,000	310.1	18,000
Montreal	837.5	54,300	2620.5	163,800	670.4	58,100
Moosonee	904.4	103,600	1916.7	97,900	480.3	24,600
Ottawa	2489.8	96,100	946.9	55,100	1606.6	97,100
Regina	1238.8	33,700	4070.6	32,000	1194.7	21,200
Resolute	459.0	42,500	2191.8	211,600	5120.9	50,700
Saskatoon	1694.8	70,200	1561.1	29,900	1334.6	31,500
Shearwater	259.9	48,700	1606.6	180,100	652.0	80,300
Torby	986.5	92,400	1342.1	113,100	1058.0	101,900
Toronto	5502.1	59,700	1469.9	81,000	—	—
Vancouver	985.0	112,600	2906.8	373,400	1114.1	211,700
Whitehorse	2140.2	61,400	3859.3	54,900	895.2	22,000
Windsor	2109.8	63,800	1778.4	130,000	1968.4	77,500
Winnipeg	550.2	14,000	8896.6	38,400	992.6	30,500
Yellowknife	193.0	10,800	377.0	13,900	1225.1	28,300
Average	1340.8	60,600	2000.1	89,500	1396.7	56,100

[a] Dash denotes no sample.

Air

About 653 cubic meters of air is drawn through a high efficiency 4-inch diameter filter during a 24-hour period. Filters are sent daily to the Radiation Protection Division Laboratory in Ottawa. A 2-inch diameter disk is removed from each filter and counted with a thin end-window Geiger flow counter system, calibrated with a Sr^{90}-Y^{90} standard. The delay period between collection and counting is one week to avoid interference from naturally-occurring radon and thoron daughters. Air data for fourth quarter 1961 are presented in table 4.

Precipitation

The amount of radioactive fallout being deposited on the ground is determined from measurements on material collected in special polythene lined rainfall pots. After transfer of the water to the sampling container, the polythene liner is removed, packed with the sample, and sent to the laboratory. Fourth quarter precipitation data are given in table 5.

A more detailed discussion of the sampling procedures, methods of analysis, and interpretation of results of the Department's radioactive fallout program is contained in the "Annual Report for 1959," Report Number CNHW (RP-3).

Previous coverage in *Radiological Health Data:*

Period	*Issue*
July 1959–June 1960	*January 1961*
Third quarter 1960	*April 1961*
Fourth quarter 1960	*August 1961*
First quarter 1961	*December 1961*
Second quarter 1961	*February 1962*
Third quarter 1961	*May 1962*

Surface Air Radon, Thoron, and Fission Product Gross Beta Concentrations at Cincinnati, Ohio

May 21–June 15, 1962

Division of Radiological Health, Public Health Service

The determination of natural background radiation in our atmosphere is useful because the exposure levels from natural radiation can be used as a base for comparative evaluations of exposures from artifically produced radionuclides. Natural radioactivity in surface air is attributed to a number of unstable nuclides not produced by man. The earth's crust contains trace amounts of uranium and thorium that occur naturally and which decay through a series of their daughter products. These decay products of uranium and thorium are introduced into surface air through their rare gas daughters, radon (radon-222) and thoron (radon-220), which in turn continue to decay through the uranium and thorium series, respectively. The radon and thoron content of air depends on the escape of these rare radioactive gases from the earth. Concentrations depend on prevailing atmospheric conditions such as

TABLE 1.—SURFACE AIR RADON (Rn^{222}), THORON (Rn^{220}), AND FISSION PRODUCT GROSS BETA CONCENTRATIONS AT CINCINNATI, OHIO, MAY 21—JUNE 15, 1962

End of sampling period	Rn^{222} 8 a.m. ($\mu\mu c/m^3$)	Rn^{222} 3 p.m. ($\mu\mu c/m^3$)	Rn^{220} ($\mu\mu c/m^3$)	Beta activity ($\mu\mu c/m^3$)
May 21	230	140	4.3	7.84
22	350	120	2.8	5.17
23	390	100	2.8	7.66
24	210	80	3.1	14.47
25	640	150	7.6	9.56
28	230	100	1.7	3.18
29	270	110	1.4	9.05
31	190	90	1.7	5.89
June 1	450	100	2.7	8.73
4	520	120	6.4	4.32
5	240	80	2.6	3.70
6	770	140	6.9	2.56
7	300	100	3.9	3.49
8	410	140	4.6	7.94
11	200	80	2.6	4.06
12	190	210	1.4	6.37
13	350	90	2.2	7.41
14	670	110	4.5	6.72
15	740	130	8.2	9.36
Average	353	112	3.6	6.21
Range of counting errors (2σ)				
Maximum	49	25	0.9	0.23
Minimum	24	15	0.4	0.06

ambient temperature, humidity, and pressure, and on soil conditions such as moisture, porosity, and temperature.

Most of the natural radioactivity in surface air is due to radon and its daughters. Thoron and its daughters contribute much less because of thoron's short half-life and hence, a lower diffusion rate from the soil.

Radiological Health Research Activities, Research Branch, Division of Radiological Health, Public Health Service, performs a continuous daily sampling program at Cincinnati for radon, thoron, and gross beta fission product concentrations in surface air. The airborne particulates, which include the daughter products of radon and thoron, are collected continuously on a membrane filter surface at a rate of approximately 1.2 cubic meters of air per hour.

Radon–222 concentrations are determined from alpha measurements made immediately after the sampling period (24 to 72 hours) has ceased. The morning radon–222 concentrations have been corrected for any radon–220 daughter interferences. The afternoon radon–222 concentrations are derived from alpha measurements made at 3 p.m., approximately 7 hours after the new sampling period has begun. These values are from the same filters that are counted at 8 a.m. the following day. The afternoon radon–222 concentrations are uncorrected for any radon–220 daughter interferences. Radon–220 concentrations are determined from alpha measurements made on the sample used to evaluate the corrected morning radon–222 concentrations, but are counted 7 hours after the sampling period has ceased. Reported values are corrected to the time of removal of the filter. The gross beta activity of airborne particulates, when measured several days after sample collection, is due principally to artificially-produced fission products.

The data are computed by an electronic data processing system which is programmed for thirteen 4-week periods per calendar year. The data for the period May 21–June 15, 1962 appear in table 1.

REFERENCE

Setter, L. R., and G. I. Coats, "The Determination of Airborne Radioactivity," *American Industrial Hygiene Association Journal*, 22:64–9 (Feb. 1961).

SECTION II.—FOOD

Strontium–90 in Raw and Processed Foods

1960, 1961, and 1962

Pharmacology Division
Food and Drug Administration

The Food and Drug Administration (FDA) conducts a sampling program to determine the concentrations of certain radionuclides in a variety of different domestic and foreign food items, as well as in animal feeds and other items which may be of importance in the food chain. Most of the domestic products examined for strontium–90 content are raw, unwashed, and unprocessed, and are collected by FDA inspectors, either directly from individual growers or from storage sheds where products are assembled before shipment. Collection records kept by the inspectors include date of collection, date of harvest, date of planting, name of grower or growers, location of farm by county or State, and name and location of marketing cooperative or dealer. When manufactured items are collected, information on the source of the raw materials is recorded.

Although samples are not collected according to a regular schedule or fixed geographical grid, the major growing areas for all of the products are sampled at intervals which usually coincide with harvest dates for the specific crop. Decisions as to what products to sample, sampling intervals, and assigned priorities are reviewed annually and incorporated into a surveillance program which is continually adjusted to cover special fallout situations associated with worldwide nuclear weapons testing. The current program comprises collection of 3500 single samples representing 50 categories of domestic, foreign, and animal foods and analysis for strontium–90. Limited analyses for cesium–137 and iodine–131 are done by gamma spectrometry.

Currently, the method used by the FDA laboratories for the analysis of strontium–90 is a modification of that outlined in the *HASL Manual of Standard Procedures* (*1*), and involves ashing the food at 550 to 600° C, dissolving the ash in hydrochloric acid, precipitating strontium and calcium as oxalates, and separating the strontium from the calcium in concentrated nitric acid. After the radium and lanthanides are scavenged with barium chromate, strontium is determined either by isolation and measurement of the daughter product yttrium–90 after secular equilibrium has been established or by direct measurement as strontium–90 with correction for ingrowth of yttrium–90. The latter method is the procedure of choice because it obviates the 3-week delay period necessary for ingrowth of yttrium–90. It also determines strontium–89, the presence of which renders this latter method currently not applicable.

Table 1 presents some limited data on the effect of processing on the strontium–90 con-

[Continued on page 332]

TABLE 1.—EFFECT OF PROCESSING ON THE STRONTIUM-90 CONTENT OF SOME FOOD ITEMS

Food item	Number of samples	$\mu\mu c$ Sr^{90}/kg				Percent reduction
		Raw		Canned or frozen		
		Average	Range	Average	Range	
Beans snap	33	16.2	2.0-98	6.9	0.4-30	58
Broccoli	1	9.5		5.0		49
Brussel sprouts	2	7.2	6.3- 8.1	3.0	2.4- 3.6	28
Carrots	21	6.8	0.8-21	5.9	0.7-23	13
Peaches	11	1.4	0.4- 4.0	0.8	0.1- 2.2	43
Spinach	30	14.8	2.7-55	12.4	1.8-36	16
Tomatoes	44	1.5	0.1- 5.3	1.0	0.1- 2.2	33

TABLE 2—STRONTIUM-90 CONTENT OF VARIOUS FOODS

Food	Origin			Harvest date	Strontium 90 ($\mu\mu c$/kg)
	Harvest region	State or country	County		
Vegetables					
Artichokes	1	Calif.	Monterey	Dec. 12, 1961	[a]4.0
Asparagus	1	Calif.	Kern	May 20, 1961	0.5
	9	N. C.	Robeson	Apr. 19, 1961	[a]5.4
Beans					
Blackeye pea	1	Calif.	Orange	Sept. 30, 1961	[a]1.4
			Fresno	Oct. 1961	[a]4.5
			San Joaquin	Oct. 1961	[a]2.6
			Stanislaus	Oct. 1961	[a]4.1
			Riverside	Nov. 1, 1961	[a]0.3
Lima	1	Calif.	Santa Barbara	Sept. 15, 1961	0.1
			Ventura	Sept. 15, 1961	2.9
			Sutter	Oct. 1961	[a]1.0
			Santa Clara	Oct. 4, 1961	[a]0.4
				Oct. 5, 1961	[a]3.7
				Oct. 6, 1961	[a]2.3
			Santa Clara	Oct. 4, 1961	[a]0.4
				Oct. 5, 1961	[a]3.7
				Oct. 6, 1961	[a]2.3
unwashed			Santa Clara	Oct. 4, 1961	[a]0.4
				Oct. 5, 1961	[a]6.8
				Oct. 6, 1961	[a]4.7
	9	N. C.	Henderson	Sept. 13, 1961	2.7
Navy	5	Mich.	Lapeer	Sept. 1, 1961	2.8
			Shiawassee	Oct. 30, 1961	[a]4.9
Pinto	1	Idaho	Twin Falls	Sept. 6, 1961	11
		Wash.	Adams	Sept. 10, 1961	6.1
	2	Colo.	Montezuma	Sept. 1, 1961	6.5
Red	1	Wash.	Benton	Aug. 1961	4.8
			Grant	Oct. 25, 1961	[a]6.1
Snap		Calif.	Monterey	Sept. 5, 1961	1.1
				Sept. 6, 1961	2.2
			Santa Cruz	Oct. 4, 1961	[a]1.0
				Oct. 4, 1961	[a]4.0
				Oct. 4, 1961	[a]7.7
	5	Mich.	Tuscola	Aug. 16, 1961	8.0
			Van Buren	Aug. 18, 1961	35
Beets					
washed, unpeeled	1	Calif.	San Diego	Feb. 15, 1962	[a]21.
		Ore.	Multnomah	Nov. 25, 1961	[a]28.
		Wash.	Spokane	Oct. 15, 1961	[a]8.7
	3	Tex.	Hidalgo	Feb. 13, 1962	[a]0.7
	4	Minn.	Anoka	Oct. 1, 1961	[a]12
	5	Wis.	Ozaukee	Nov. 10, 1961	[a]10
			Waukesha	Nov. 10, 1961	[a]12
	11	N. Y.	Ontario	Nov. 14, 1961	[a]5.8
			Wayne	Nov. 7, 1961	[a]5.8
				Nov. 15, 1961	[a]12
			Yates	Nov. 14, 1961	[a]12

[a]Harvested after September 15, 1961. [b]Refers to date of import. [c]Collection date. [d]Manufacture date.

TABLE 2.—STRONTIUM-90 CONTENT OF VARIOUS FOODS—Continued

Food	Origin			Harvest date	Strontium-90 (μμc/kg)
	Harvest region	State or country	County		
Beets (continued) unwashed	3	Tex.	Hidalgo	Nov. 6, 1962	[a]0.9
peeled	1	Calif.	Los Angeles	Mar. 21, 1962	[a]8.7
			Riverside	Mar. 8, 1962	[a]1.0
Broccoli	1	Calif.	Santa Barbara	Feb. 14, 1962	[a]35
	11	N. Y.	Monroe, Orleans	Nov. 14, 1961	[a]9.8
Brussel Sprouts		N. Y.	Monroe, Orleans	Nov. 12, 1961	[a]6.3
			Niagara, Orleans	Nov. 6, 1961	[a]8.1
Cabbage	1	Calif.	Imperial	Feb. 21, 1962	[a]1.4
			Riverside	Mar. 6, 1962	[a]4.4
		Ore.	Multnomah	Dec. 7, 1961	[a]10
	3	Tex.	Bexar	Jan. 6, 1962	[a]3.4
			Dimmit	Jan. 16, 1962	[a]2.9
			Hidalgo	Jan. 5, 1962	[a]2.1
				Jan. 17, 1962	[a]2.8
				Feb. 13, 1962	[a]4.6
				Mar. 3, 1962	[a]8.8
			Zavala	Nov. 8, 1960	2.6
				Jan. 17, 1962	[a]2.6
	5	Mich.	Ionia	Oct. 5, 1961	[a]3.7
			Muskegon	Nov. 29, 1961	[a]4.8
			Wayne	Sept. 13, 1961	5.8
	7	Ind.	St. Joseph	Nov. 5, 1961	[a]3.1
	8	Ala.	Mobile	Dec. 8, 1961	[a]32
		La.	Jefferson	Dec. 5, 1961	[a]17
			LaFourche	Nov. 19, 1961	[a]9.9
			Plaquemines	Dec. 4, 1961	[a]9.4
				Dec. 6, 1961	[a]8.2
			St. Charles	Nov. 25, 1961	[a]8.1
			St. James	Nov. 25, 1961	[a]8.1
	9	Fla.	Palm Beach	Jan. 16, 1962	[a]15
			St. Johns	Jan. 22, 1962	[a]22
		S. C.	Beaufort	Feb. 8, 1962	[a]31
			Charleston	Dec. 1961	[a]45
	10	Va.	Carroll	Nov. 9, 1961	[a]17
	11	N. Y.	Cortland	Nov. 5, 1961	[a]12
			Onondaga	Nov. 8, 1961	[a]14
			Ontario, Yates	Nov. 10, 1961	[a]7.3
				Nov. 10, 1961	[a]12
			Orleans	Nov. 8, 1961	[a]4.3
				Nov. 8, 1961	[a]8.2
				Nov. 8, 1961	[a]9.9
				Nov. 9, 1961	[a]5.1
		Pa.	Cambria	Oct. 5, 1961	[a]12
Carrots	1	Calif.	Riverside	Jan. 31, 1961	[a]1.0
				Feb. 27, 1962	[a]1.5
			Ventura	Feb. 14, 1962	[a]3.2
	3	Ariz.	Yuma	Jan. 15, 1962	[a]1.7
		Tex.	Bexar	Jan. 17, 1962	[a]2.0
			Hidalgo	Jan. 5, 1962	[a]0.9
				Feb. 13, 1962	[a]3.0
				Feb. 27, 1962	[a]2.6
				Mar. 3, 1962	[a]2.2
				Mar. 3, 1962	[a]4.6
			Zavala	Jan. 1962	[a]2.4
				Jan. 16, 1962	[a]2.9
	5	Mich.	Antrim	Nov. 1, 1961	[a]7.7
			Cass, Calhoun	Nov. 1, 1961	[a]2.8
			Newaygo	Oct. 10, 1961	[a]3.2
				Nov. 26, 1961	[a]2.9
		Wis.	Waukesha	Jan. 10, 1962	[a]5.4
	11	N. Y.	Ontario	Nov. 1, 1961	[a]5.2
				Nov. 7, 1961	[a]4.4
				Nov. 11, 1961	[a]9.6
				Nov. 14, 1961	[a]5.6
				Nov. 14, 1961	[a]8.3
			Wayne	Nov. 3, 1961	[a]2.8
				Nov. 13, 1961	[a]2.3
			Yates	Nov. 3, 1961	[a]2.3

See p. 321 for footnotes.

TABLE 2.—STRONTIUM-90 CONTENT OF VARIOUS FOODS—Continued

Food	Origin			Harvest date	Strontium-90 (μμc/kg)
	Harvest region	State or country	County		
Carrots (continued)	12	Mass.	Middlesex	Sept. 7, 1960	16
Cauliflower	1	Ore.	Multnomah	Dec. 5, 1961	*10
	11	N. Y.	Monroe	Nov. 14, 1961	*1.3
			Niagara, Orleans	Nov. 16, 1961	*4.5
			Orleans	Nov. 14, 1961	*4.3
			Suffolk	Dec. 5, 1961	*6.4
Celery	1	Calif.	Monterey	Oct. 31, 1961	*1.7
				Dec. 4, 1961	*1.9
			Orange	Mar. 5, 1962	*7.1
			San Diego	Feb. 14, 1962	*17
	3	Tex.	Starr	Jan. 8, 1962	*6.1
	5	Mich.	Allegan	July 1960	14
			Kent	Sept. 5, 1960	4.4
			Lapeer	May 15, 1961	8.0
	9	Fla.	Palm Beach	Jan. 12, 1961	2.7
				Dec. 5, 1961	*0.9
				Jan. 16, 1962	*4.2
				Jan. 16, 1962	*5.4
			Sarasota	Jan. 16, 1962	*37
			Seminole	Feb. 15, 1962	*22
	11	N. Y.	Orange	Sept. 15, 1960	4.5
			Wayne	Sept. 3, 1960	3.4
				Sept. 30, 1960	4.0
Collards	8	Ala.	Chilton	Nov. 28, 1961	*42
		La.	St. Bernard	Dec. 9, 1961	*33
	9	N. C.	Beaufort	Dec. 12, 1961	*63
	10	Va.	Norfolk	Apr. 19, 1962	*209
Egg plant	9	Fla.	Broward	Jan. 10, 1962	*6.5
			Hardee	Jan. 12, 1962	*4.3
Kale	10	Va.	Norfolk	Apr. 19, 1962	*128
Lettuce	1	Calif.	Contra Costa	Oct. 18, 1961	*1.2
				Oct. 18, 1961	*1.3
			Monterey	Nov. 2, 1960	15
				Dec. 7, 1961	*21
				Dec. 7, 1961	*26
			Riverside	Dec. 11, 1961	*4.2
				Mar. 5, 1962	*6.8
	2	Colo.	Costilla	Aug. 31, 1960	3.4
	3	N. Mex.	Dona Ana	Oct. 14, 1960	2.3
			Valencia	Sept. 14, 1960	1.1
		Tex.	Hidalgo	Feb. 8, 1961	3.2
	5	Wis.	Waushara	Oct. 6, 1960	4.7
	9	Fla.	Hillsborough	Dec. 6, 1961	*1.5
			Palm Beach	Jan. 17, 1962	*0.7
			Sarasota	Feb. 5, 1962	*64
				Feb. 10, 1962	*19
				Feb. 10, 1962	*22
				Feb. 10, 1962	*30
				Feb. 10, 1962	*46
				Feb. 13, 1962	*22
				Feb. 13, 1962	*178
			Sumter	Dec. 6, 1961	*1.4
Mustard greens	1	Calif.	Santa Clara	Feb. 13, 1961	*91
Okra	8	La.	St. Charles	Sept. 25, 1961	*16
Onions washed, unpeeled	1	Calif.	Monterey	Sept. 25, 1961	*2.1
			Siskiyou	Sept. 21, 1961	*1.3
	5	Mich.	Mason	Oct. 12, 1961	*0.9
			Newaygo	Sep. 8, 1961	1.2
				Oct. 10, 1961	*1.0
				Oct. 11, 1961	*1.4
				Oct. 12, 1961	*0.7
			Ottawa	Aug. 1961	0.9
	7	Ind.	St. Joseph	Oct. 1961	*0.8
		Ohio	Huron	Sept. 1, 1961	1.9
	11	N. Y.	Madison	Nov. 16, 1961	*1.1
				Nov. 30, 1961	*1.0
			Wayne	Sept. 15, 1961	0.5

See p. 321 for footnotes.

TABLE 2.—STRONTIUM-90 CONTENT OF VARIOUS FOODS—Continued

Food	Origin			Harvest date	Strontium-90 (μμc/kg)
	Harvest region	State or country	County		
Onions (continued) peeled	2	S. C.	Beaufort	Jan. 19, 1962	[a]22
green, tops & roots removed	1	Calif.	Fresno	Nov. 29, 1961	[a]1.2
	3	Ariz.	Maricopa	Mar. 3, 1962	[a]7.0
	8	Ala.	Mobile	Dec. 8, 1961	[a]60
Parsley	1	Calif.	Fresno	Jan. 16, 1962	[a]95
				Jan. 23, 1962	[a]126
			Monterey	Dec. 7, 1961	[a]73
				Feb. 8, 1962	[a]64
				Feb. 8, 1962	[a]66
			San Benito	Jan. 25, 1962	[a]107
				Jan. 30, 1962	[a]126
			Santa Cruz	Jan. 31, 1962	[a]141
Peas	1	Calif.	Kern, Tulare	Dec. 5, 1961	[a]1.0
			Stanislaus	May 10, 1961	1.0
			Ventura	May 3, 1961	0.7
		Idaho	Latah	Aug. 12, 1960	4.7
			Nez Perce	Aug. [illegible], 1960	4.3
		Ore.	Umatilla	July 5, 1960	6.2
				July 15, 1960	5.3
		Wash.	Spokane	Aug. 1, 1960	2.4
			Whitman	Aug. 1, 1960	4.3
	9	Fla.	Hillsborough	Dec. 5, 1961	[a]14
				Dec. 5, 1961	[a]20
Peppers sweet	8	La.	Plaquemines	Nov. 20, 1961	[a]1.7
chili		Mexico		Mar. 8, 1962[b]	[a]1.9
dried		Japan		Dec. 7, 1961[b]	[a]14
				Dec. 11, 1961[b]	[a]2.6
				Dec. 28, 1961[b]	[a]88
				Jan. 9, 1962[b]	[a]27
				Feb. 7, 1962[b]	[a]21
Potatoes White, whole	1	Ore.	Malheur	Sept. 15, 1961	1.1
		Wash.	Adams	Aug. 1, 1961	0.7
			Kittitas	Sept. 1961	0.4
	4	Minn.	Marshall	Sept. 1961	1.6
			Pennington	Oct. 1, 1961	[a]1.4
			Red Lake	Oct. 1, 1961	[a]2.4
			Roseau	Oct. 1, 1961	[a]1.1
		N. D.	Grand Forks	Sept. 1961	1.4
				Sept. 20, 1961	[a]0.8
			Traill	Oct. 1, 1961	[a]0.8
	5	Mich.	Bay	Sept. 1, 1960	8.8
			Lapeer	Oct. 1961	[a]0.4
				Oct. 1961	[a]0.4
			Macomb	Nov. 1, 1961	[a]1.0
			Marion	Oct. 15, 1961	[a]0.0
			Missaukee	Sept. 25, 1961	[a]0.9
			St. Clair	Oct. 5, 1961	[a]1.3
			Shiawassee	Dec. 18, 1961	[a]0.7
	5	Wis.	Langlade	Sept. 1961	2.0
				Oct. 20, 1961	[a]1.2
			Racine	Oct. 1, 1961	[a]3.4
			Waukesha	Oct. 1961	[a]2.0
	6	Ill.	Carroll	Sept. 25, 1961	[a]2.6
			Whiteside	Oct. 1, 1961	[a]2.0
	7	Ohio	Clinton	Oct. 16, 1961	[a]3.5
			Richland, Wayne	Oct. 5, 1961	[a]1.2
	11	Pa.	Bucks	Oct. 10, 1961	[a]2.3
			Cambria	Oct. 10, 1961	[a]1.7
			Indiana	Oct. 21, 1961	[a]2.0
			Jefferson	Oct. 10, 1961	[a]1.4
			Somerset	Oct. 8, 1961	[a]1.3
peeled	1	Calif.	Riverside	Feb. 17, 1962	[a]0.6
	4	Minn.	Polk	Sept. 1961	0.7
	5	Mich.	Bay	Sept. 1961	0.7
			Newaygo	Oct. 27, 1961	[a]0.4
		Wis.	Waupaca	Oct. 1, 1961	[a]2.0

See p. 321 for footnotes.

TABLE 2.—STRONTIUM-90 CONTENT OF VARIOUS FOODS—Continued

Food	Origin			Harvest date	Strontium-90 (μμc/kg)
	Harvest region	State or country	County		
Potatoes (continued)	7	Ind.	St. Joseph	Oct. 1, 1961	[a]0.0
	11	Pa.	Erie	Sept. 20, 1961	[a]0.4
peelings	1	Calif.	Riverside	Feb. 17, 1961	[a]4.7
	4	Minn.	Polk	Sept. 1961	2.8
	5	Mich.	Bay	Sept. 1961	3.0
			Newaygo	Oct. 27, 1961	[a]2.6
		Wis.	Waupaca	Oct. 1, 1961	[a]5.9
	7	Ind.	St. Joseph	Oct. 1, 1961	[a]0.7
	11	Pa.	Erie	Sept. 20, 1961	[a]6.0
sweet	3	Tex.	Van Zandt	Oct. 15, 1961	[a]16
	9	Georgia	Thomas	Nov. 1961	[a]44
	10	Maryland	Wicomico	Oct. 1961	[a]23
		New Jersey	Atlantic	Oct. 9, 1961	[a]20
				Oct. 14, 1961	[a]19
				Oct. 15, 1961	[a]21
Pumpkin	1	Ore.	Yamhill	Oct. 10, 1961	[a]11
		Wash.	King	Oct. 15, 1961	[a]3.4
	2	Colo.	Boulder	Oct. 15, 1962	[a]3.2
				Oct. 15, 1962	[a]3.6
	6	Ill.	LaSalle	Oct. 1961	[a]5.4
			Lee	Oct. 1961	[a]3.5
			Will	Oct. 1961	[a]4.6
	9	N. C.	Henderson	Nov. 1961	[a]0.5
				Nov. 1961	[a]3.9
	10	Md.	Howard, Montgomery	Nov. 8, 1961	[a]7.7
		Va.	Roanoke	Oct. 8, 1961	[a]4.8
Radishes	1	Calif.	Los Angeles	Mar. 8, 1962	[a]2.6
				Mar. 20, 1962	[a]10
			San Diego	Feb. 15, 1962	[a]3.8
	9	Fla.	Palm Beach	Dec. 11, 1961	[a]6.1
Soybeans	3	Tex.	Lubbock	Oct. 1961	[a]20
			Swisher	Oct. 1961	[a]17
	4	Minn.	Kandiyohi	Sept. 1961	18
	5	Wis.	Pierce	Sept. 1961	42
			St. Croix	Sept. 1961	34
	6	Ill.	Lee	Oct. 1961	[a]26
			Whiteside	Oct. 1961	[a]24
	7	Ind.	Adams	Oct. 15, 1961	[a]11
			DeKalb	Oct. 15, 1961	[a]20
	9	Ga.	Peach	Nov. 1961	[a]116
		S. C.	Allendale	Oct. 25, 1961	[a]151
			Orangeburg	Nov. 15, 1961	[a]108
	11	Pa.	Bucks	Sept. 1961	64
Spinach	1	Calif.	Los Angeles	Feb. 27, 1962	[a]167
			Orange	Mar. 19, 1962	[a]55
			Ventura	Feb. 14, 1962	[a]74
		Wash.	King	Sept. 11, 1961	[a]6.8
			Pierce	Sept. 27, 1961	[a]14
	3	Tex.	Hidalgo	Jan. 31, 1962	[a]33
	10	Md.	Kent	Apr. 10, 1962	[a]104
	11	N. Y.	Genesee	Oct. 2, 1961	[a]3.1
			Yates	Sept. 29, 1961	[a]2.9
Squash	5	Mich.	Lapeer	Oct. 15, 1961	[a]2.2
				Oct. 15, 1961	[a]2.2
Turnips					
whole	1	Calif.	San Diego	Feb. 15, 1962	[a]2.8
	8	La.	St. John the Baptist	Nov. 19, 1961	[a]3.6
				Nov. 26, 1961	[a]12
				Nov. 26, 1961	[a]9.4

See p. 321 for footnotes.

TABLE 2.—STRONTIUM-90 CONTENT OF VARIOUS FOODS—Continued

Food	Origin			Harvest date	Strontium-90 (μμc/kg)
	Harvest region	State or country	County		
Turnips (continued)	11	N. Y.	Erie	Nov. 1, 1961	[a]6.5
		Pa.	Bucks	Nov. 30, 1961	[a]32
peeled	1	Calif.	Orange	Feb. 28, 1962	[a]5.9
			Riverside	Mar. 9, 1962	[a]1.6
Fruit					
Apples	1	Calif.	Santa Cruz	Oct. 1961	[a]0.2
				Oct. 30, 1961	[a]0.3
	5	Mich.	Berrien	Oct. 10, 1961	[a]2.0
	7	Ohio	Erie, Lorain	Sept. 20, 1961	[a]1.5
	11	N. Y.	Essex	Sept. 18, 1961	[a]1.5
			Washington	Sept. 18, 1961	[a]0.5
			Wayne	Oct. 9, 1961	[a]1.3
Avocado	1	Calif.	Orange	Feb. 1, 1962	[a]0.4
			San Diego	Feb. 2, 1962	[a]0.1
peeled & pitted			Ventura	Feb. 15, 1962	[a]0.8
			San Diego	Jan. 15, 1962	[a]1.0
				Feb. 13, 1962	[a]2.1
			Santa Barbara	Feb. 13, 1962	[a]4.7
Bananas		Panama		Jan. 17, 1962	[a]0.1
Cranberries	10	N. J.	Burlington	Nov. 5, 1961	[a]110
				Nov. 12, 1961	[a]32
				Nov. 20, 1961	[a]78
			Ocean	Nov. 7, 1961	[a]56
Cucumber	9	Fla.	Lee	Mar. 10, 1962	[a]8.3
Figs		Greece		Oct. 16, 1961[b]	[a]7.2
				Oct. 16, 1961[b]	[a]9.0
				Oct. 27, 1961[b]	[a]3.5
		Italy		Oct. 6, 1961[b]	[a]6.7
		Turkey		Oct. 16, 1961[b]	[a]9.0
				Oct. 30, 1961[b]	[a]8.5
				Nov. 29, 1961[b]	[a]9.5
Grapes	11	N. Y.	Chautauqua	Nov. 3, 1961	[a]7.9
		Pa.	Erie	June 28, 1961	4.6
				Nov. 9, 1961	[a]4.6
				Nov. 9, 1961	[a]5.3
				Nov. 9, 1961	[a]7.6
Grapefruit, whole	1	Calif.	Riverside	Mar. 8, 1962	[a]0.4
	3	Ariz.	Yuma	Mar. 15, 1962	[a]2.0
	9	Fla.	Orange	Jan. 24, 1962	[a]11
			Polk	Jan. 13, 1962	[a]16
peeled	3	Ariz.	Maricopa	Jan. 24, 1962	[a]1.4
		Tex.	Cameron	Dec. 7, 1961	[a]0.8
			Hidalgo	Dec. 7, 1961	[a]1.7
				Jan. 3, 1962	[a]1.5
			Willacy	Jan. 9, 1962	[a]1.5
Lemons, peeled	1	Calif.	San Diego	Mar. 2, 1962	[a]1.8
			Ventura	Dec. 12, 1961	[a]1.1
	3	Ariz.	Maricopa	Jan. 24, 1962	[a]1.1
Limes	9	Fla.	Dade	Jan. 4, 1962	[a]13
			Pasco	Jan. 17, 1962	[a]9.0
Olives	1	Calif.	Butte	1961	12
			Los Angeles	Jan. 31, 1962	[a]3.1
Oranges, whole	9	Fla.	Indian River	Jan. 9, 1962	[a]27
			Lake	Jan. 18, 1962	[a]12
				Jan. 18, 1962	[a]15
			St. Lucie	Jan. 9, 1962	[a]24
peeled	1	Calif.	Riverside	Jan. 31, 1962	[a]1.5
				Feb. 28, 1962	[a]0.8
			San Bernadino	Feb. 1, 1962	[a]1.0
				Mar. 16, 1962	[a]1.1
			San Diego	Feb. 15, 1962	[a]2.2
Peaches	1	Calif.	Stanislaus	Sept. 4, 1961	0.4
	5	Mich.	Berrien	Sept. 28, 1961	[a]1.1
			Mason	Sept. 26, 1961	[a]4.0
			Oceana	Sept. 20, 1961	[a]1.6

See p. 321 for footnotes.

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TABLE 2.—STRONTIUM-90 CONTENT OF VARIOUS FOODS—Continued

Food	Origin			Harvest date	Strontium-90 (μμc/kg)
	Harvest region	State or country	County		
Pears	1	Ore.	Hood River	Oct. 1961	[a]1.0
		Wash.	Douglas	Aug. 1961	0.4
	11	Pa.	Bucks	Oct. 15, 1961	[a]3.2
Pineapple, canned		Phillipine Islands		Dec. 28, 1961[b]	[a]2.3
		Hawaii		Feb. 7, 1961[b]	3.1
Tomatoes					
ripe	1	Calif.	Butte	Nov. 1, 1961	[a]0.5
			Monterey	Oct. 30, 1961	[a]0.3
			San Diego	Feb. 15, 1962	[a]0.2
			Santa Clara	Sept. 18, 1961	[a]0.2
			Yolo	Sept. 11, 1961	0.5
	5	Mich.	Lenawee	Aug. 31, 1961	0.7
	7	Ind.	Blackford	Sept. 27, 1961	[a]0.3
			Wells	Sept. 28, 1961	[a]0.5
	9	Fla.	Dade	Mar. 2, 1961	1.8
	10	Va.	Northumberland	Aug. 25, 1960	2.6
green	9	Fla.	Hillsborough	Jan. 16, 1962	[a]5.8
			Manatee	Jan. 16, 1962	[a]2.8
Cereals					
Barley	1	Idaho	Nez Perce	July 20, 1961	11
		Ore.	Marion	Sept. 1961	4.4
		Wash.	Whitman	July 1961	4.0
	2	Colo.	Morgan	July 1, 1961	15
		Utah	Sevier	Sept. 10, 1961 Sept. 10, 1961	11 11
	3	N. Mex.	Dona Ana	June 5, 1961	12
		Okla.	McClain	July 1961	13
		Tex.	Randall	Jan. 17, 1962	[a]9.6
	4	Minn.	Dakota	Aug. 15, 1961	15
			Hennepin	Aug. 15, 1961 Aug. 15, 1961	23 26
	5	Mich.	Bay, Saginaw	July 20, 1961	8.0
			Tuscola	July 20, 1961	9.0
		Wis.	Calumet	Aug. 1, 1961	14
			Kewaunee	Aug. 15, 1961	25
	10	Del.	Sussex	June 1961	37
		Md.	Carroll	June 1961	23
		N. J.	Hunterdon	Sept. 1961	27
		Va.	Roanoke	June 15, 1961	12
	11	N. Y.	Genesee	Aug. 1, 1961	9.2
Corn, meal	4	Kans.	Shawnee	Sept. 20, 1960	0.1
shelled	1	Idaho	Canyon	Oct. 15, 1961	[a]0.0
		Ore.	Malheur	Nov. 15, 1961	[a]0.3
			Marion	Oct. 1, 1961	[a]1.0
		Wash.	Yakima	Oct. 1, 1961	[a]0.4
	3	Okla.	Garfield	Oct. 1961	[a]1.3
		Tex.	Lamb	Jan. 1, 1962	[a]3.3
	4	Kans.	Shawnee	Sept. 20, 1960	0.1
	5	Mich.	Calhoun	Nov. 1, 1961	[a]0.6
		Wis.	Pierce	Nov. 1, 1961 Nov. 1, 1961	[a]1.1 [a]3.7
	7	Ind.	Marshall	Oct. 1961	[a]0.7
			St. Joseph	Nov. 1, 1961	[a]1.2
shelled	9	Ga.	Floyd	Oct. 15, 1961	[a]1.6
	10	Va.	Louisa	Oct. 1960	2.7

See p. 321 for footnotes.

TABLE 2.—STRONTIUM-90 CONTENT OF VARIOUS FOODS—Continued

Food	Origin			Harvest date	Strontium-90 (μμc/kg)
	Harvest region	State or country	County		
Corn (continued)	11	N. Y.	Genesee	Oct. 1, 1961	[a]0.6
			Seneca	Nov. 1961	[a]0.7
		Pa.	York	Oct. 30, 1961	[a]1.1
Oats	1	Idaho	Bonneville	Aug. 1960	17
				Aug. 1961	15.3
				Aug. 1961	12
				Sept. 5, 1961	14
			Latah	Sept. 1, 1961	6.0
		Ore.	Marion	Sept. 1961	20
		Wash.	Whitman	Aug. 1961	4.8
	2	Colo.	Rio Grande	Aug. 5, 1961	16
	3	Tex.	Randall	Aug. 1961	39
	4	Minn.	Wright	Aug. 1961	25
		S. Dak.	Davison	Aug. 1961	13
	5	Mich.	Calhoun	July 15, 1961	23
			Kalamazoo	July 25, 1961	16
	6	Ill.	Stephenson	Aug. 1961	26
	7	Ohio	Fulton	Aug. 1, 1961	14
	11	N. Y.	Genesee	Aug. 1, 1961	21
			Seneca, Ontario	Aug. 15, 1961	11
			Wyoming	Aug. 20, 1961	30
		Pa.	Bucks	Aug. 1961	20
Rye	1	Ore.	Marion	Oct. 15, 1961	[a]13
		Wash.	Adams	Aug. 1961	6.5
	2	Wyo.	Platte	Aug. 1961	9.4
	3	Okla.	Blaine	June 1961	21
			McClain	May 1961	31
	6	Ill.	Whiteside	July 10, 1961	31
Wheat					
bran	11	N. Y.	Niagara	Aug. 1, 1961	23
			Yates	Aug. 1, 1961	64
		Pa.	Adams, York	July 1961	80
durum	2	Mont.	Pondera	Aug. 30, 1961	3.3
	4	N. Dak.	Nelson	Sept. 1961	11
flour	11	N. Y.	Niagara	Aug. 1, 1961	4.3
			Yates	Aug. 1, 1961	1.5
		Pa.	Adams, York	July 1961	6.0
spring	1	Ore.	Umatilla	Jan. 25, 1962[e]	[a]2.5
	2	Mont.	Teton	Aug. 15, 1961	6.1
	4	N. Dak.	Emmons	Aug. 15, 1961	14
		S. Dak.	Deuel	Aug. 1961	6.0
winter	1	Ore.	Marion	Aug. 1961	1.8
		Wash.	Adams	Aug. 1961	3.0
			Grant	Sept. 1961	3.2
			Whitman	Aug. 1961	6.1
	3	Okla.	Caddo	June 1961	24
			Garfield	May 1961	21
			Oklahoma	June 1961	21
			Seminole	June 1961	33
	4	N. Dak.	Burleigh	Aug. 1961	9.3
			Kidder	Sept. 15, 1961	17
			Morton	Aug. 15, 1961	14
		S. Dak.	Deuel	Aug. 1961	8.7
			Pennington	July 15, 1960	20
	5	Mich.	Berrien	Aug. 1, 1961	5.5
			Ionia	Aug. 1, 1961	22
			Monroe	July 10, 1961	5.8
	6	Ill.	Carroll	July 15, 1961	30
			Lee	July 1961	18
			Stephenson	July 1961	16

See p. 321 for footnotes.

TABLE 2.—STRONTIUM-90 CONTENT OF VARIOUS FOODS—Continued

Food	Origin			Harvest date	Strontium-90 (μμc/kg)
	Harvest region	State or country	County		
	7	Ohio	Clinton	1960	33
			Hancock, Sandusky, Seneca, Wood	July 15, 1961	15
	9	Ga.	Bartow	1960	13
		N. C.	Harnett	July 1961	55
	10	N. J.	Hunterdon	July 1961	20
	11	N. Y.	Niagara	Aug. 1, 1961	15
			Yates	Aug. 1, 1961	12
				Aug. 1, 1961	17
		Pa.	Adams, York	July 1961	23
			Bucks	July 1961	33
			Chester	July 14, 1960	32
			Huntingdon, Mifflin	July 15, 1960	31
			Lancaster	Aug. 1960	20
Dairy products Cheese, cheddar	1	Idaho	Bonneville	Mar. 1, 1962	[a]20
		Ore., Wash.		Jan. 1962	[a]38
				Feb. 5, 1962	[a]48
		Wash.		July 1961	63
				Dec. 1960	24
	2	Utah		Jan. 5, 1961	27
				Jan. 31, 1961	48
	4	Minn.	Carver, Mcleod, Sibley		[a]28
				Apr. 16, 1962[d]	[a]28
	6	Ill.		Dec. 1, 1961[d]	[a]53
				Dec. 19, 1961[d]	[a]46
				Jan. 8, 1962[d]	[a]48
				Feb. 8, 1962[d]	[a]48
	7	Ohio		Dec. 31, 1961[d]	[a]59
	11	N. Y.	Erie	Oct. 19, 1961[d]	[a]23
				Nov. 8, 1961[d]	[a]40
Eggs shell	4	Minn.		Mar. 6, 1962	[a]390
	5	Mich.	Kalamazoo	Dec. 11, 1961	[a]201
				Feb. 1, 1962	[a]222
substance	4	Minn.		Mar. 5, 1962	[a]1.5
	5	Mich.		Sept. 25, 1961	[a]0.9
			Kalamazoo	Dec. 11, 1961	[a]0.7
				Feb. 1, 1962	[a]1.0
	10	N. J.	Cumberland	Jan. 21, 1962	[a]2.4
Milk condensed	11	Pa.		Sept. 15, 1961[d]	24
				Nov. 2, 1961[d]	[a]4.0
evaporated	1	Idaho		Jan. 1961[d]	8.4
	8	La.		Jan. 1961	13
	11	N. Y.		Jan. 19, 1961	51
Fish Bonita, canned in oil		Peru		Dec. 11, 1961[b]	[a]0.4
				Dec. 13, 1961[b]	[a]0.0
				Dec. 13, 1961[b]	[a]0.1
				Dec. 13, 1961[b]	[a]1.0
Clams fresh	1	Wash.		Jan. 1961	0.4
	12	Mass.		Jan. 1962	[a]0.3
				Mar. 1961	0.9
frozen		Mexico		Dec. 28, 1961[b]	[a]0.5
				Feb. 9, 1962[b]	[a]0.0
razor, frozen	1	Wash.		Mar. 1961	0.2
				Nov. 1961	[a]0.0
Flounder, fillet	12	Mass.		Dec. 8, 1961	[a]0.6
				Jan. 18, 1962	[a]0.3
				Jan. 18, 1962	[a]0.6
Haddock	12	Mass.		Sept. 22, 1961[b]	[a]0.4

See p. 321 for footnotes.

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TABLE 2.—STRONTIUM-90 CONTENT OF VARIOUS FOODS—Continued

Food	Origin			Harvest date	Strontium-90 (μμc/kg)
	Harvest region	State or country	County		
Lobster, frozen	12	Mass.		Jan. 19, 1962	[a]0.4
		Australia		Dec. 4, 1961[b]	[a]0.0
				Mar. 9, 1962[b]	[a]0.2
		Brazil		Dec. 11, 1961[b]	[a]0.6
		Chile		Dec. 7, 1961[b]	[a]0.3
		Denmark		Dec. 8, 1961[b]	[a]0.2
		S. Africa		Nov. 23, 1961[b]	[a]1.5
Oysters, fresh	1	Wash.		Jan. 4, 1962	[a]0.0
				Jan. 5, 1962	[a]0.4
				Jan. 11, 1962	[a]0.1
				Mar. 6, 1962	[a]0.2
	10	Md.		Mar. 16, 1962	[a]0.1
				Mar. 30, 1962	[a]2.7
Salmon, canned		Alaska		June 7, 1961	0.0
				July 10, 1961	0.0
				Dec. 20, 1961	[a]0.5
				Dec. 20, 1961	[a]1.4
Sardines, canned	12	Maine		Sept. 1961	0.4
				Jan. 5, 1962	[a]2.6
		Denmark		Dec. 5, 1961[b]	0.0
		Norway		Feb. 6, 1962[b]	[a]4.2
				Feb. 20, 1962[b]	[a]2.0
		Portugal		Dec. 1, 1961[b]	[a]3.5
				Dec. 8, 1961[b]	[a]8.1
				Jan. 2, 1962[b]	[a]2.6
				Feb. 5, 1962[b]	[a]3.1
Shrimp, frozen	1	Calif.		Oct. 1961	[a]3.0
		Colombia		Dec. 8, 1961[b]	[a]0.8
				Dec. 11, 1961[b]	[a]0.7
		Ecuador		Dec. 8, 1961[b]	[a]0.6
		India		Dec. 8, 1961[b]	[a]0.2
				Dec. 8, 1961[b]	[a]3.1
		Mexico		Dec. 1, 1961[b]	[a]0.1
				Dec. 21, 1961[b]	[a]0.0
		Panama		Dec. 8, 1961[b]	[a]0.0
				Dec. 12, 1961[b]	[a]0.0
				Dec. 12, 1961[b]	[a]0.2
Tuna, canned in brine		Angola		Feb. 2, 1962[b]	[a]0.4
		Japan		Dec. 5, 1961[b]	[a]0.2
				Dec. 6, 1961[b]	0.1
				Dec. 12, 1961[b]	[a]0.0
				Dec. 15, 1961[b]	[a]0.3
				Dec. 22, 1961[b]	[a]0.1
				Jan. 1962[b]	[a]2.8
				Feb. 5, 1962[b]	[a]0.0
				Feb. 12, 1962[b]	[a]0.3
		Peru		Feb. 28, 1962[b]	[a]0.0
		Portugal		Jan. 24, 1962[b]	[a]0.2
Baby foods Vegetables, strained Carrots	1	Calif.		Sept. 16, 1960[d]	0.4
				Sept. 1, 1961[d]	0.5
	9	N. C.		Oct. 20, 1960[d]	3.9
	11	N. Y.		Nov. 15, 1960[d]	1.8
Potato, sweet	1	Calif.		Sept. 1960[d]	3.4
Squash	5	Mich.		Sept. 15, 1960[d]	2.2
Fruits, strained Applesauce	1	Calif.		Sept. 1, 1961[d]	0.4
Banana		Central America		1960[d]	0.3
Pears	1	Calif.		Sept. 1, 1961[d]	1.6
Plums	5	Mich.		Sept. 16, 1960[d]	1.0

See p. 321 for footnotes.

TABLE 2.—STRONTIUM-90 CONTENT OF VARIOUS FOODS—Continued

Food	Origin			Harvest date	Strontium-90 (μμc/kg)
	Harvest region	State or country	County		
Cereals					
Barley	5	Mich.		Oct. 13, 1960[d]	8.3
Corn flour	6	Ill.		Feb. 2, 1961[d]	0.3
Hi-Protein	5	Mich.		July 19, 1960[d]	29
				Mar. 8, 1961[d]	24
				Apr. 1961[d]	49
Mixed	5	Mich.		Feb. 2, 1961[d]	3.1
Oat flour	5	Mich.		Dec. 28, 1960[d]	5.4
				Mar. 8, 1961[d]	6.7
	6	Iowa		Nov. 16, 1960[d]	6.8
Oatmeal	5	Mich.		June 24, 1960[d]	25
				Nov. 1960[d]	22
				Apr. 18, 1961[d]	5.8
Rice	5	Mich.		Aug. 25, 1960[d]	3.2
				Nov. 16, 1960[d]	1.7
				Jan. 18, 1961[d]	4.5
	11	Pa.		Oct. 11, 1960[d]	2.6
Beverage products					
Cocoa beans		Brazil		Jan. 11, 1962[b]	[a]8.1
		Dominican Republic		Mar. 7, 1962[b]	[a]36
		Ghana		Jan. 11, 1962[b]	[a]12
Coffee beans		Brazil		Jan. 5, 1961[b]	12
				Nov. 28, 1961[b]	[a]7.4
				Dec. 1961[b]	[a]10
				Dec. 1961[b]	[a]13
				Dec. 11, 1961[b]	[a]9.6
				Jan. 1962[b]	[a]6.0
				Jan. 12, 1962[b]	[a]14
		Cameroons		Dec. 5, 1961[b]	[a]26
				Jan. 25, 1962[b]	[a]23
		Congo		Dec. 5, 1961[b]	[a]30
		Costa Rica		Dec. 4, 1961[b]	[a]1.8
		Ecuador		Feb. 8, 1962[b]	[a]4.1
		Ghana		Jan. 12, 1962[b]	[a]9.0
		Guatemala		Nov. 13, 1961[b]	[a]16
				Dec. 1, 1961[b]	[a]47
				Dec. 4, 1961[b]	[a]41
		Ivory Coast		Jan. 17, 1962[b]	[a]16
				Jan. 17, 1962[b]	[a]17
		Mexico		Jan. 4, 1962[b]	[a]45
				Jan. 17, 1962[b]	[a]25
				Jan. 23, 1962[b]	[a]21
				Jan. 24, 1962[b]	[a]26
		Nigeria		Jan. 1962[b]	[a]9.0
				Jan. 1962[b]	[a]13
				Feb. 5, 1962[b]	[a]32
Tea		British E. Africa		Feb. 26, 1962[b]	[a]47
				Mar. 6, 1962[b]	[a]41
		Ceylon		Feb. 21, 1962[b]	[a]320
				Mar. 12, 1962[b]	[a]183
				Mar. 16, 1962[b]	[a]222
				Mar. 19, 1962[b]	[a]245
		Formosa		Dec. 21, 1961[b]	[a]294
		Hong Kong		Nov. 1, 196.[b]	[a]236
		India		Feb. 12, 1962[b]	[a]148
				Feb. 26, 1962[b]	[a]179
				Mar. 6, 1962[b]	[a]1053
				Mar. 12, 1962[b]	[a]160
				Mar. 12, 1962[b]	[a]466
				Mar. 15, 1962[b]	[a]244
		Indonesia		Feb. 19, 1962[b]	[a]110
				Mar. 5, 1962[b]	[a]213
				Mar. 13, 1962[b]	[a]20
				Apr. 3, 1962[b]	[a]260

See p. 321 for footnotes.

TABLE 2.—STRONTIUM-90 CONTENT OF VARIOUS FOODS—Continued

Food	Origin			Harvest date	Strontium-90 (μμc/kg)
	Harvest region	State or country	County		
		Japan		Dec. 21, 1961[b] Jan. 30, 1962[b] Jan. 31, 1962[b]	[a]192 [a]215 [a]352
		Kenya-Uganda		Mar. 14, 1962[b] Mar. 14, 1962[b]	[a]56 [a]61
Nuts Brazil		Bolivia		Dec. 11, 1961[b] Dec. 4, 1961[b]	[a]77 [a]45
		Brazil		Dec. 5, 1961[b] Dec. 7, 1961[b] Dec. 11, 1961[b] Dec. 12, 1961[b]	[a]43 [a]77 [a]63 [a]47
Cashew		India		June 1961[b] June 9, 1961[b] Dec. 4, 1961[b] Dec. 4, 1961[b] Dec. 12, 1961[b]	1.3 1.3 [a]1.5 [a]1.6 [a]0.7
		Mozambique		Feb. 12, 1962[b]	[a]0.0
Peanuts	3	Okla.	Caddo	Sept. 1961	58
	8	Ala.	Covington Houston Pike	Dec. 6, 1961 Dec. 6, 1961 Dec. 7, 1961	[a]57 [a]50 [a]53
	9	Ga.	Crisp Tift	Sept. 1961 Oct. 1961	27 [a]30
		N. C.	Halifax	Mar. 13, 1962	[a]19
Pecans	9	Ga.	Mitchell Thomas	Nov. 1961 Nov. 1961	[a]5.5 [a]4.7
Walnuts	1	Calif.	Riverside Ventura	Nov. 1961 Oct. 15, 1961 Nov. 1961	[a]0.8 [a]1.1 [a]0.0
		Ore.	Marion	Oct. 1961	[a]5.7
Miscellaneous Caraway seed		Netherlands		Dec. 4, 1961[b] Dec. 5, 1961[b] Dec. 14, 1961[b] Jan. 9, 1962[b]	[a]77 [a]84 [a]115 [a]79
Ginger		Cuba (probably China)		Dec. 11, 1961[b]	[a]1.1
Hops	1	Ore.	Marion	Aug. 15, 1961	13
		Wash.	Yakima	Aug. 1961	56

See p. 321 for footnotes.

tent of some food items, while table 2 presents raw data on strontium-90 content of various foods. Dates in table 2 refer to the dates of harvest or collection, with all products indicated as harvested before or after September 15, 1961, which is the date of arrival of fallout in the U.S. from the U.S.S.R. nuclear testing series. Regional groupings of states of origin which appear in table 2 are arbitrarily numbered according to the schedule below.

1. Pacific	California, Idaho, Nevada, Oregon, Washington
2. Rocky Mountain	Colorado, Montana, Wyoming, Utah
3. Southwestern	Arizona, New Mexico, Oklahoma, Texas
4. North Central	Kansas, Minnesota, Nebraska, North Dakota, South Dakota,
5. Great Lakes	Michigan, Wisconsin
6. Mid Central	Arkansas, Illinois, Iowa, Missouri
7. East Central	Indiana, Kentucky, Ohio
8. South Central	Alabama, Louisiana, Mississippi, Tennessee
9. Southeastern	Florida, Georgia, North Carolina, South Carolina
10. Mid Atlantic	Delaware, Maryland, New Jersey, Virginia, West Virginia
11. Mid Eastern	New York, Pennsylvania
12. New England	Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont

Summary

In general, the appearance of strontium-90 contamination associated with 1961 nuclear weapons testing is becoming more marked in those samples harvested in the first quarter of 1962 than in those harvested in the fourth quarter of 1961. Products harvested in the spring and early summer of 1962 can be expected to show increased amounts of contamination.

REFERENCE:

(*1*) U.S. Atomic Energy Commission, *HASL Manual of Standard Procedures*, NYO-4700, Office of Technical Services, U.S. Department of Commerce, Washington 25, D.C. (February 1960), Price $1.75.

Previous coverage in *Radiological Health Data*:

Period	*Issue*
1958 and 1959	*May 1960*
1958, 1959, and 1960	*January 1961*
1960	*August 1961*
1959 and 1960	*September 1961*
1958, 1959, 1960, and 1961	*December 1961*
1960 and 1961	*April 1962*
1961	*June 1962*
1960, 1961, and 1962	*August 1962*

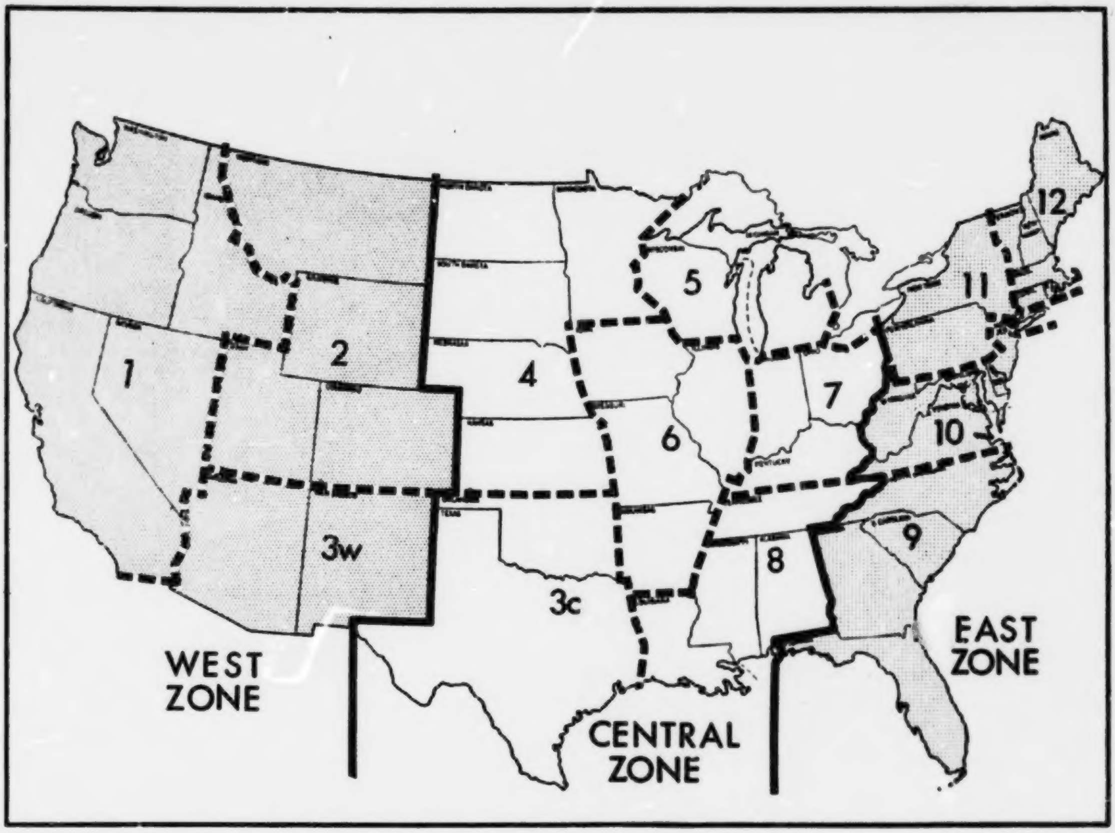

FIGURE 1.—HARVEST REGIONS AND ZONES

Tri-City Diet Study*

November 1961–February 1962

Joseph Rivera
Health and Safety Laboratory, U.S. Atomic Energy Commission

Approximately every 3 months since May 1960, estimates of the strontium-90 content of average diets for individuals living in New York City, San Francisco, and Chicago have been made by the Health and Safety Laboratory.

Selected foods, representing 19 food categories, are purchased at each of these 3 cities about every 3 months and are analyzed for strontium-90. Using data from the U.S. Department of Agriculture, "Household Food Survey of 1955," the annual consumption by an individual can be grouped into the same 19 food categories. The annual dietary intake of strontium-90 and calcium can then be estimated by summing the contributions from each category. Some food types are assumed to be representative of larger food categories, such as liquid milk for dairy products in general. Hence, in the tables that follow, the values shown for food consumption may not be directly related to the original data in the source document.

The consumption data from the "Household Food Survey of 1955" are based on a weight as purchased basis. Before the food samples for the Tri-City Diet Study are ashed for radiochemical analysis, they are prepared to a certain degree, as if for actual consumption; for example, fruits are peeled, eggs are shelled, and poultry is de-boned. Therefore, the concentration of radioactivity in foods as reported in the Tri-City Diet Study is based on the trimmed weight. No correction is made for the wasted food. Contributions of strontium-90 from tap water are not included in table 1, but measurements during 1960 and 1961 indicate that the contribution would be in the range of 100 to 200 μμc strontium-90 per year. It is assumed in making this estimate that the average daily intake of tap water is 1.2 liters.

Results obtained from the seventh sampling of foods (November 1961–February 1962) are presented in table 1. The variation with time of the daily intake of strontium-90 at the 3 cities is plotted in figure 1.

The previously noted geographic pattern of distribution of strontium-90 in foods is seen to persist in this last sampling. New York City has the highest levels of dietary strontium-90 contamination, San Francisco has the lowest levels, while Chicago has intermediate levels. Milk continues to be the predominant source of strontium-90 in the diet because of its high annual consumption.

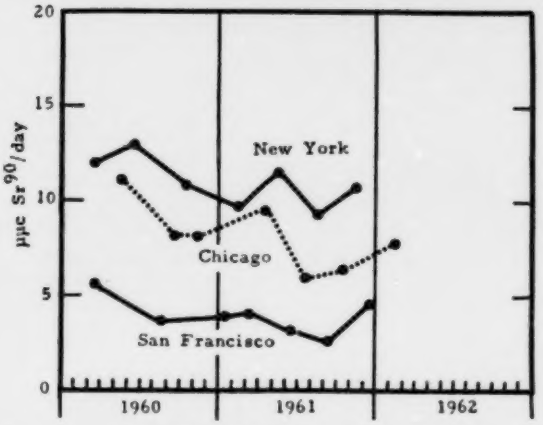

FIGURE 1.—DAILY INTAKE OF STRONTIUM-90 IN TRI-CITY TOTAL DIETS

There is a marked increase in the estimated strontium-90 intake noted in the seventh sampling. This increase is probably due to the contamination of foods resulting from fallout from the October 1961 U.S.S.R. test series. There are insufficient data available at this time to quantitate the contribution of the debris to the strontium-90 levels in U.S. foods exactly. Preliminary measurements of strontium-89 in milk and flour, however, indicate that roughly 5 to 10 percent of the strontium-90 found in milk purchased in the seventh sampling came from the U.S.S.R. test series, while roughly 30 to 50 percent of the strontium-90 in flour was of this origin. It is difficult to understand how

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* Data from *Quarterly Summary Report, HASL 127*, July 1, 1962.

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TABLE 1.—STRONTIUM-90 LEVELS OF DIET—SEVENTH SAMPLING

Food type	Annual consumption	New York City November 1961		Chicago February 1962		San Francisco December 1961	
	(kg/yr)	μμc/kg	μμc/yr	μμc/kg	μμc/yr	μμc/kg	μμc/yr
Whole grain products	11	9.6	106	7.7	85	3.9	43
Refined grain products	37	6.4	236	6.6	243	6.9	254
Refined grain flour	43	5.0	215	7.3	313	1.7	72
Milk, liquid	221	7.9	1755	4.6	1017	2.3	498
Potatoes	45	5.6	252	7.3	330	1.6	72
Macaroni	3	4.4	13	3.1	9	0.6	2
Beans, dried	3	7.8	23	22.9	69	11.7	35
Vegetables, canned	20	12.3	246	3.7	74	1.3	27
Vegetables, fresh	43	4.4	188	6.1	264	5.5	228
Vegetables, root	17	7.0	120	4.3	74	4.7	81
Fruit, canned	26	1.3*	34*	2.0	51	0.8	20
Fruit juices	19	4.2	80	2.4	46	1.7	33
Fruit, fresh	68	6.5	443	1.5	104	2.2	118
Rice	3	2.6	8	2.0	6	0.6	2
Eggs	16	1.5	24	2.0	32	0.9	14
Fish, fresh	8	0.6*	5*	1.2	9	0.2	1
Fish, shell	1	1.8	2	0.4	0	0.9	1
Meat	72	0.6	43	1.2	86	0.5	36
Poultry	17	3.7	62	0.4	7	0.4	7
Total annual intake	674	—	3855	—	2819	—	1590

* Estimated from sixth sampling.

flour could have been contaminated with fresh fallout so quickly, since it was presumably made of wheat grown prior to the U.S.S.R. tests. When data on the strontium-89 content of foods from the spring sampling are available, it is hoped that this anomaly will be resolved. It should then be possible to make more precise estimates of the contribution of the U.S.S.R. test series to the strontium-90 content of the tri-city diets.

Using the totals given in table 1, the following average concentrations, in μμc Sr^{90}/gm Ca, may be expressed in units of annual intake: New York, 10.1; Chicago, 7.8; San Francisco, 4.2. This calculation was based on calcium data obtained from the first two sampling periods. Despite the fact that there is some variability in the results obtained from analyses of individual food categories, the total intake of calcium was calculated to be 383 grams per person per year, with a standard deviation of less than 5 percent. Because of the relative constancy of the average annual intake of calcium, due to its strong dependence on the relatively constant calcium content of milk, analyses of food categories other than milk for calcium were discontinued after the second sampling.

Previous coverage in *Radiological Health Data:*

Period	*Issue*
First sampling (March–May 1960)	*April 1961*
Second sampling (June–September 1960)	*June 1961*
Third sampling (October 1960–January 1961)	*October 1961*
Fourth sampling (February–April 1961)	*December 1961*
Fifth sampling (May–July 1961)	*March 1962*
Sixth sampling (August–October 1961)	*June 1962*

SECTION III.—MILK

Radionuclide Analyses of Pasteurized Milk

PASTEURIZED MILK MONITORING PROGRAM
April and May 1962

Division of Radiological Health, and
Division of Environmental Engineering & Food Protection,
Public Health Service

Milk monitoring has been conducted by the Public Health Service since early 1957, when the first program was established to develop suitable sampling methods and radiochemical analytical procedures. Raw milk was initially selected for investigation. During this program, it became evident that a broader sampling program was necessary—one more directly related to the milk consumed by the population. The result was the initiation, in the first quarter of 1960, of a pasteurized milk sampling program designed to provide data representative of the milk consumed in selected municipalities. Both programs were reported concurrently until June 1961 to permit comparison of the differences between the earlier, limited, milkshed sampling results and those of the new program.

The June 1961 raw milk sampling results, reported in the November 1961 *Radiological Health Data (RHD)*, represent the last regular publication of such data. A summary discussion of the raw milk sampling program in the December 1961 *RHD* presented the gross relationship between fallout and the occurrence of fission products in milk determined from this study.

During April and May 1962, the surveillance of pasteurized milk was conducted at 61 stations, with the cooperation of State and local milk sanitation agencies who have been shipping samples to the PHS Southwestern, Southeastern, and Northeastern Radiological Health Laboratories for analysis (see figure 1). Publication in *RHD* follows about 3½ months after sample collection because of time required for shipment, processing, decay-product buildup, data compilation, and publication procedures.

The current program emphasizes (1) measurement of the concentrations of radioactivity in samples of pasteurized milk consumed by the public in various regions of the country, and (2) provision of at least one sampling point within virtually all states and additional points when indicated by widely varying conditions of the milk supply or the need to cover large population groups. Each sample is composited in proportion to the volume of milk sold by those plants supplying not less than 90 percent

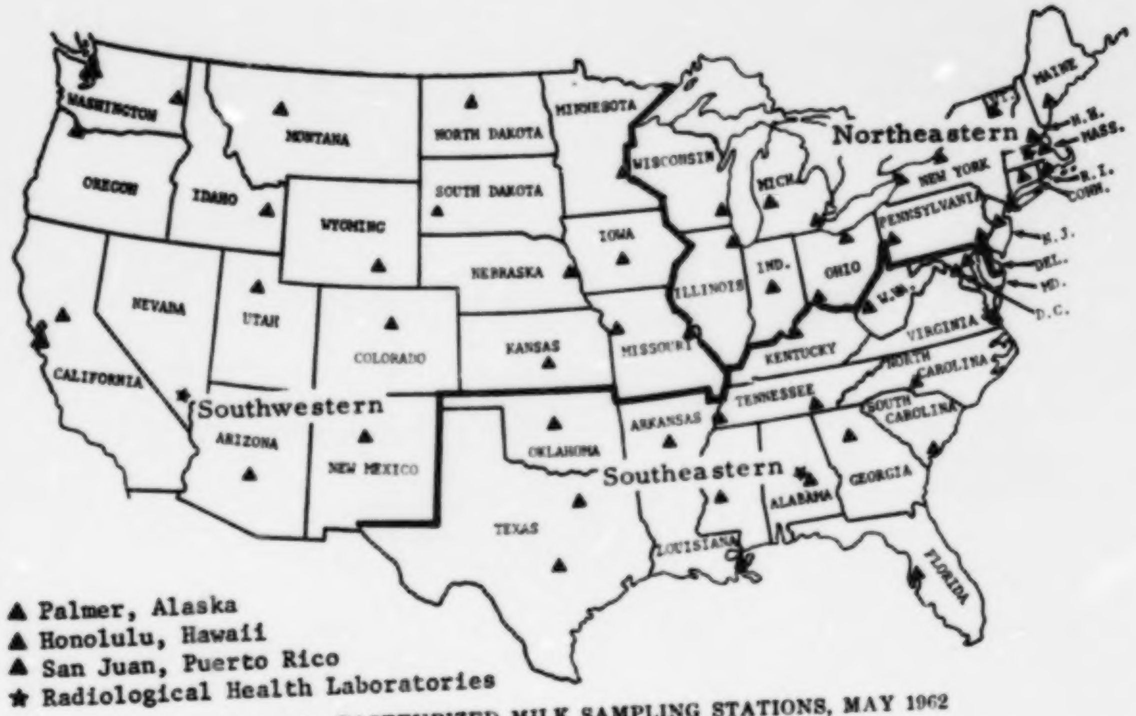

FIGURE 1.—PASTEURIZED MILK SAMPLING STATIONS, MAY 1962

of a city's milk supply. Prior to September 15, 1961, this composite sample was taken from one day's sales per month and was as representative of a community's total supply as could be achieved under practical conditions. Since September 15, the sampling schedule has been accelerated.

During April 1962, sampling on a weekly basis was performed at most stations. Following the appearance of iodine-131 in pasteurized milk from mid-western states beginning on May 13, a readjustment of the sampling schedule to a semi-weekly basis was made for several stations in this area. For a more detailed discussion of the iodine-131 appearance, see "Mid-May Iodine-131 in the Midwest," Section V, page 350. All surveillance data are subject to continuing review and evaluation to observe unusual patterns or concentrations which may require immediate attention and adjustment in the pasteurized milk monitoring.

Iodine-131, cesium-137, and barium-140 are determined by gamma scintillation spectroscopy, while strontium-89 and strontium-90 are determined following radiochemical separation. The minimum detectable concentrations in units of μμc/liter are: Sr^{89}, 5; Sr^{90}, 1; I^{131}, 10; Cs^{137}, 5; and Ba^{140}, 10.

Strontium-90 Profile

In the previous 4 issues, *RHD* published graphical presentations of the average monthly concentrations of strontium-90 in pasteurized milk from 36 selected cities from the monitoring program (see table 2 for publication month). An additional 16 cities are similarly represented in figure 2. Each graph shows the strontium-90 concentrations in milk from selected cities in the 4 major geographic regions* of the United States. Regional differences can be seen in these graphs. In most cases the West has had the lowest strontium-90 concentrations during the past two years. The South had the highest values, while the Northeast and North Central have been in the middle range.

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* These regions correspond to those used by the U.S. Department of Agriculture for their tabulations of average "per person" quantities of food consumed per week, as presented in the August, September, and October 1960 *RHD*.

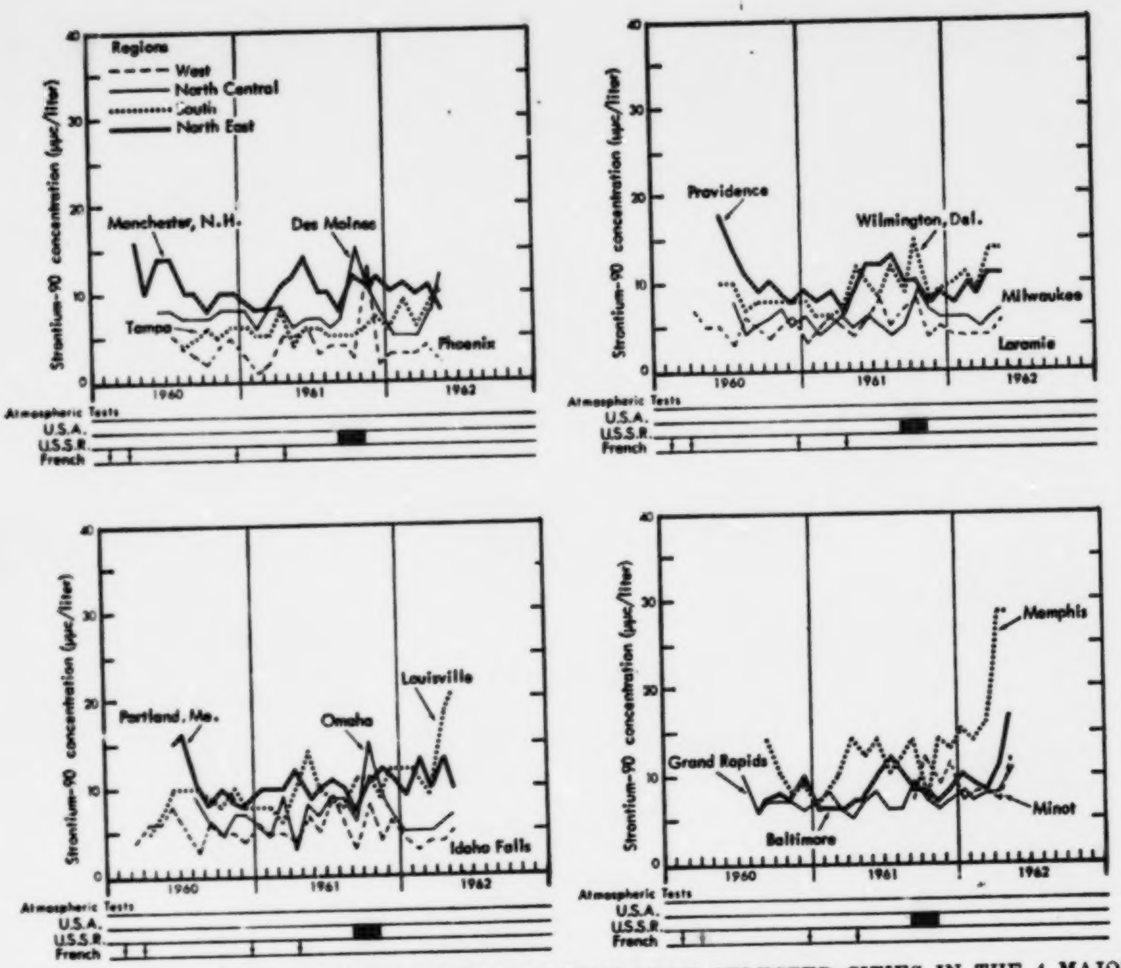

FIGURE 2.—STRONTIUM-90 CONCENTRATIONS IN MILK FROM SELECTED CITIES IN THE 4 MAJOR GEOGRAPHIC REGIONS OF THE UNITED STATES

Strontium-90 and Strontium-89 Geographical Distribution

Figure 3 geographically generalizes the strontium-90 and strontium-89 concentrations during April and May 1962 by means of concentration contours. It must be remembered when interpreting these plots that they are based on concentrations in pasteurized milk representing milk sold in 61 cities distributed throughout the United States. Thus, intervening milk sheds for smaller cities and their effect on intra and interstate milk distribution patterns are not taken into consideration. This distribution of cities allows concentration contours to be reasonably used for graphically presenting this data. The pattern in evidence during the winter months of December, January, February, and March has changed during April and May. A general nationwide increase in strontium-90 concentration is apparent beginning in April and continuing during May. Nationwide strontium-89 concentration continued to increase during April with the highest concentrations in the South. In May, though, this upward trend of strontium-89 reversed itself in the South, aparently due to the natural radioactive decay of the strontium-89 (half life, 51 days). In the North, strontium-89 concentrations had been relatively low due to the practice of feeding cattle during the winter on silage harvested prior to the resumption of atmospheric nuclear weapons testing. During

TABLE 1.—RADIOACTIVITY IN PASTEURIZED MILK, APRIL 1962

[Average radioactivity concentrations in $\mu\mu c$/liter]

Area		Calcium (g/liter)		Strontium-89		Strontium-90		Iodine-131		Cesium-137		Barium-140	
City	State	First quarter	Avg. for month	First quarter	Avg. for month	First quarter	Avg. for month	First quarter	Avg. for month	First quarter	Avg. for month	First quarter	Avg. for month
Montgomery	Ala.	1.14	1.21	40	170	12	23	<10	<10	20	55	20	40
Palmer	Alaska	1.05	1.11	5	15	6	6	<10	<10	10	<5	<10	10
Phoenix	Ariz.	1.05	1.08	25	20	3	3	<10	<10	5	<5	<10	<10
Little Rock	Ark.	1.18	1.14	105	380	22	40	<10	<10	25	120	20	40
Sacramento	Calif.	1.07	1.09	15	45	3	6	<10	<10	5	10	<10	<10
San Francisco	Calif.	1.10	1.13	40	80	5	10	10	10	10	20	<10	20
Denver	Colo.	1.07	1.15	10	10	5	6	<10	<10	10	<5	<10	10
Hartford	Conn.	1.14	1.16	<5	5	9	10	<10	<10	5	10	<10	<10
Wilmington	Del.	1.17	1.20	5	55	10	14	<10	<10	5	20	<10	<10
Washington	D. C.	1.16	1.16	<5	40	8	12	<10	<10	<5	25	<10	<10
Tampa	Fla.	1.22	1.21	20	30	7	9	<10	<10	55	90	<10	<10
Atlanta	Ga.	1.19	1.23	120	175	13	25	<10	<10	30	85	20	20
Honolulu	Hawaii	1.04	1.10	50	40	5	6	10	<10	10	15	<10	<10
Idaho Falls	Idaho	1.07	1.07	<5	5	4	4	10	<10	5	<5	<10	20
Chicago	Ill.	1.13	1.14	<5	<5	6	7	<10	<10	<5	5	<10	<10
Indianapolis	Ind.	1.20	1.20	10	30	9	12	<10	<10	5	15	<10	<10
Des Moines	Iowa	1.07	1.09	5	30	5	8	<10	<10	10	5	<10	10
Wichita	Kans.	1.07	1.07	20	35	7	8	<10	<10	5	5	<10	10
Louisville	Ky.	1.17	1.16	20	110	11	18	<10	<10	10	25	<10	<10
New Orleans	La.	1.22	1.22	325	285	28	40	<10	<10	70	135	50	30
Portland	Maine	1.20	1.15	<5	<5	11	13	<10	<10	15	20	<10	<10
Baltimore	Md.	1.17	1.18	<5	30	9	11	<10	<10	5	20	<10	<10
Boston	Mass.	1.19	1.18	<5	<5	10	12	<10	<10	15	10	<10	<10
Detroit	Mich.	1.16	1.15	<5	5	6	8	<10	<10	<5	5	<10	<10
Grand Rapids	Mich.	1.19	1.23	<5	<5	8	8	<10	<10	10	10	<10	<10
Minneapolis	Minn.	1.07	1.09	5	5	6	5	10	<10	10	<5	<10	10
Jackson	Miss.	1.27	1.26	245	340	23	37	<10	<10	40	90	40	40
Kansas City	Mo.	1.05	1.07	15	60	7	11	10	<10	10	<5	<10	20
St. Louis	Mo.	1.07	1.07	10	40	8	10	<10	<10	10	5	10	10
Helena	Mont.	1.08	1.05	5	20	4	4	20	<10	<5	<5	<10	20
Omaha	Nebr.	1.09	1.14	10	30	5	6	<10	<10	5	<5	<10	10
Manchester	N. H.	1.17	1.18	<5	<5	10	11	<10	<10	25	25	<10	<10
Trenton	N. J.	1.16	1.13	<5	20	8	8	<10	<10	5	10	<10	<10
Albuquerque	N. Mex.	1.07	1.10	10	20	4	3	20	10	<5	5	10	20
Buffalo	N. Y.	1.13	1.15	<5	<5	8	8	<10	<10	5	5	<10	<10
New York	N. Y.	1.13	1.14	<5	<5	9	9	<10	<10	<5	5	<10	<10
Syracuse	N. Y.	1.14	1.14	<5	<5	7	8	<10	<10	5	10	<10	<10
Charlotte	N. C.	1.20	1.24	25	125	12	17	<10	<10	<5	50	<10	<10
Minot	N. D.	1.04	1.08	<5	5	8	7	<10	<10	10	5	<10	10
Cincinnati	Ohio	1.18	1.16	15	60	10	14	<10	<10	<5	20	<10	<10
Cleveland	Ohio	1.16	1.17	<5	<5	8	9	<10	<10	5	5	<10	<10
Oklahoma City	Okla.	1.17	1.18	40	95	9	16	<10	<10	<5	20	<10	10
Portland	Ore.	1.08	1.10	25	80	7	12	<10	<10	15	30	<10	20
Philadelphia	Pa.	1.16	1.16	<5	20	9	11	<10	<10	<5	15	<10	<10
Pittsburgh	Pa.	1.17	1.19	<5	10	11	11	<10	<10	<5	10	<10	<10
San Juan	P. R.	1.14	1.14	110	115	8	12	<10	<10	25	60	20	20
Providence	R. I.	1.16	1.16	<5	5	9	11	<10	<10	10	15	<10	<10
Charleston	S. C.	1.22	1.20	80	145	14	23	<10	<10	25	75	10	20
Rapid City	S. D.	1.09	1.05	10	10	6	7	10	<10	15	<5	10	20
Chattanooga	Tenn.	1.24	1.24	110	340	15	29	<10	<10	20	110	20	40
Memphis	Tenn.	1.21	1.20	120	240	15	28	<10	<10	<5	45	20	40
Austin	Tex.	1.16	1.16	25	45	5	8	<10	<10	<5	15	<10	<10
Dallas	Tex.	1.21	1.20	55	160	10	17	<10	<10	5	50	<10	20
Salt Lake City	Utah	1.08	1.10	<5	5	4	4	10	<10	5	<5	<10	<10
Burlington	Vt.	1.16	1.18	<5	<5	7	8	<10	<10	10	10	<10	<10
Norfolk	Va.	1.22	1.18	20	75	11	12	<10	<10	5	30	<10	<10
Seattle	Wash.	1.07	1.08	15	50	6	10	<10	<10	15	20	<10	10
Spokane	Wash.	1.07	1.14	<5	20	6	7	10	<10	10	10	<10	<10
Charleston	W. Va.	1.15	1.17	10	35	9	12	<10	<10	<5	10	<10	<10
Milwaukee	Wis.	1.20	1.21	<5	<5	6	6	<10	<10	5	5	<10	<10
Laramie	Wyo.	1.05	1.08	<5	10	4	4	10	<10	10	5	<10	10
Network average		1.14	1.15	30	63	8.7	12.0	<10	<10	11	25	<10	10

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TABLE 2.—RADIOACTIVITY IN PASTEURIZED MILK, MAY 1962

[Average radioactivity concentrations in $\mu\mu c$/liter]

Area		Calcium (g/liter)		Strontium-89		Strontium-90		Iodine-131		Cesium-137		Barium-150		Sr^{90} profile in *RHD*
City	State	First quarter	Avg. for month	First quarter	Avg. for month	First quarter	Avg. for month	First quarter	Avg. for month	First quarter	Avg. for month	First quarter	Avg. for month	
Montgomery	Ala.	1.14	1.19	40	90	12	17	<10	20	20	65	20	10	
Palmer	Alaska	1.05	1.09	5	40	6	8	<10	<10	10	25	<10	<10	
Phoenix	Ariz.	1.05	1.06	25	10	3	2	<10	<10	5	10	<10	<10	Sept 62
Little Rock	Ark.	1.18	1.18	105	180	22	40	<10	20	25	80	20	40	July 62
Sacramento	Calif.	1.07	1.07	15	30	3	5	<10	20	5	20	<10	<10	Aug 62
San Francisco	Calif.	1.10	1.12	40	60	5	9	10	<10	10	20	<10	<10	May 62
Denver	Colo.	1.07	1.15	10	20	5	6	<10	10	10	5	<10	<10	Aug 62
Hartford	Conn.	1.14	1.18	<5	10	9	9	<10	<10	5	30	<10	<10	Aug 62
Wilmington	Del.	1.17	1.17	5	50	10	14	<10	<10	5	45	<10	<10	Sept 62
Washington	D. C.	1.16	1.16	<5	50	8	15	<10	<10	<5	35	<10	10	
Tampa	Fla.	1.22	1.21	20	25	7	10	<10	<10	55	110	<10	<10	Sept 62
Atlanta	Ga.	1.19	1.19	120	115	13	20	<10	10	30	85	20	20	May 62
Honolulu	Hawaii	1.04	1.05	50	30	5	5	10	10	10	30	<10	10	
Idaho Falls	Idaho	1.07	1.07	<5	[a]15	4	5	10	<10	5	10	<10	<10	Sept 62
Chicago	Ill.	1.13	1.14	<5	30	6	12	<10	40	<5	20	<10	20	May 62
Indianapolis	Ind.	1.20	1.18	10	55	9	18	<10	10	5	50	<10	20	Aug 62
Des Moines	Iowa	1.07	1.06	5	90	5	12	<10	90	10	30	<10	30	Sept 62
Wichita	Kans.	1.07	1.08	20	85	7	11	<10	220	5	20	<10	20	July 62
Louisville	Ky.	1.17	1.20	20	110	11	21	<10	20	10	35	<10	10	Sept 62
New Orleans	La.	1.22	1.24	325	220	28	34	<10	<10	70	155	50	30	June 62
Portland	Maine	1.20	1.26	<5	10	11	10	<10	<10	15	40	<10	<10	Sept 62
Baltimore	Md.	1.17	1.17	<5	45	9	17	<10	20	5	55	<10	<10	Sept 62
Boston	Mass.	1.19	1.18	<5	15	10	12	<10	<10	15	40	<10	<10	June 62
Detroit	Mich.	1.16	1.18	<5	25	6	10	<10	10	<5	25	<10	<10	Aug 62
Grand Rapids	Mich.	1.19	1.25	<5	20	8	11	<10	<10	10	20	<10	<10	Sept 62
Minneapolis	Minn.	1.07	1.06	5	55	6	11[a]	10	120	10	20	<10	20	June 62
Jackson	Miss.	1.27	1.27	245	175	23	33	<10	<10	40	85	40	30	Aug 62
Kansas City	Mo.	1.05	1.08	15	120	7	17	10	200	10	30	<10	50	Aug 62
St. Louis	Mo.	1.07	1.06	10	100	8	14	<10	30	10	30	10	10	June 62
Helena	Mont.	1.08	1.10	5	15	4	11	20	10	<5	25	<10	<10	July 62
Omaha	Nebr.	1.09	1.16	10	40	5	8	<10	30	5	10	<10	<10	Sept 62
Manchester	N. H.	1.17	1.20	<5	10	10	8	<10	<10	25	45	<10	<10	Sept 62
Trenton	N. J.	1.16	1.16	<5	25	8	11	<10	<10	5	15	<10	<10	Aug 62
Albuquerque	N. Mex.	1.07	1.08	10	10	4	3	20	20	<5	5	10	10	July 62
Buffalo	N. Y.	1.13	1.21	<5	15	8	8	<10	<10	5	30	<10	<10	Aug 62
New York	N. Y.	1.13	1.12	<5	20	9	14	<10	20	<5	30	<10	<10	May 62
Syracuse	N. Y.	1.14	1.16	<5	20	7	10	<10	20	5	20	<10	<10	July 62
Charlotte	N. C.	1.20	1.20	25	70	12	22	<10	<10	<5	40	<10	20	July 62
Minot	N. D.	1.04	1.12	<5	60	8	12	<10	20	10	20	<10	<10	Sept 62
Cincinnati	Ohio	1.18	1.18	15	70	10	19	<10	20	<5	25	<10	20	Aug 62
Cleveland	Ohio	1.16	1.14	<5	45	8	10	<10	<10	5	20	<10	<10	July 62
Oklahoma City	Okla.	1.17	1.14	40	115	9	19	<10	20	<5	60	<10	20	
Portland	Ore.	1.08	1.14	2[a]	135	7	24	<10	<10	15	70	<10	<10	Aug 62
Philadelphia	Pa.	1.16	1.16	<5	40	9	15	<10	<10	<5	40	<10	<10	July 62
Pittsburgh	Pa.	1.17	1.15	<5	35	11	13	<10	<10	<5	30	<10	<10	June 62
San Juan	P. R.	1.14	1.11	110	60	8	8	<10	20	25	50	20	20	
Providence	R. I.	1.16	1.18	<5	20	9	11	<10	20	10	40	<10	<10	Sept 62
Charleston	S. C.	1.22	1.21	80	85	14	19	<10	<10	25	65	10	20	Aug 62
Rapid City	S. D.	1.09	1.03	10	10	6	4	10	<10	15	<5	10	<10	
Chattanooga	Tenn.	1.24	1.26	110	160	15	32	<10	20	30	85	20	20	
Memphis	Tenn.	1.21	1.23	120	125	15	28	<10	<10	<5	35	20	20	Sept 62
Austin	Tex.	1.16	1.20	25	30	5	8	<10	<10	<5	20	<10	<10	June 62
Dallas	Tex.	1.21	1.16	55	95	10	20	<10	20	5	80	<10	20	Aug 62
Salt Lake City	Utah	1.08	1.11	<5	35	4	7	10	<10	5	20	<10	<10	June 62
Burlington	Vt.	1.16	1.11	<5	10	7	8	<10	<10	10	30	<10	<10	Aug 62
Norfolk	Va.	1.22	1.20	20	60	11	18	<10	10	5	80	<10	10	Aug 62
Seattle	Wash.	1.07	1.12	15	130	6	24	<10	<10	15	70	<10	<10	June 62
Spokane	Wash.	1.07	1.14	<5	80	6	16	10	<10	10	35	<10	<10	Aug 62
Charleston	W. Va.	1.15	1.20	10	95	9	20	<10	20	<5	40	<10	20	
Milwaukee	Wis.	1.20	1.22	<5	5	6	7	<10	10	5	15	<10	<10	Sept 62
Laramie	Wyo.	1.05	1.08	<5	25	4	6	10	20	10	15	<10	10	Sept 62
Network average		1.14	1.15	30	60	8.7	13.9	<10	21	11	38	<10	12	

[a] Average based on two months.

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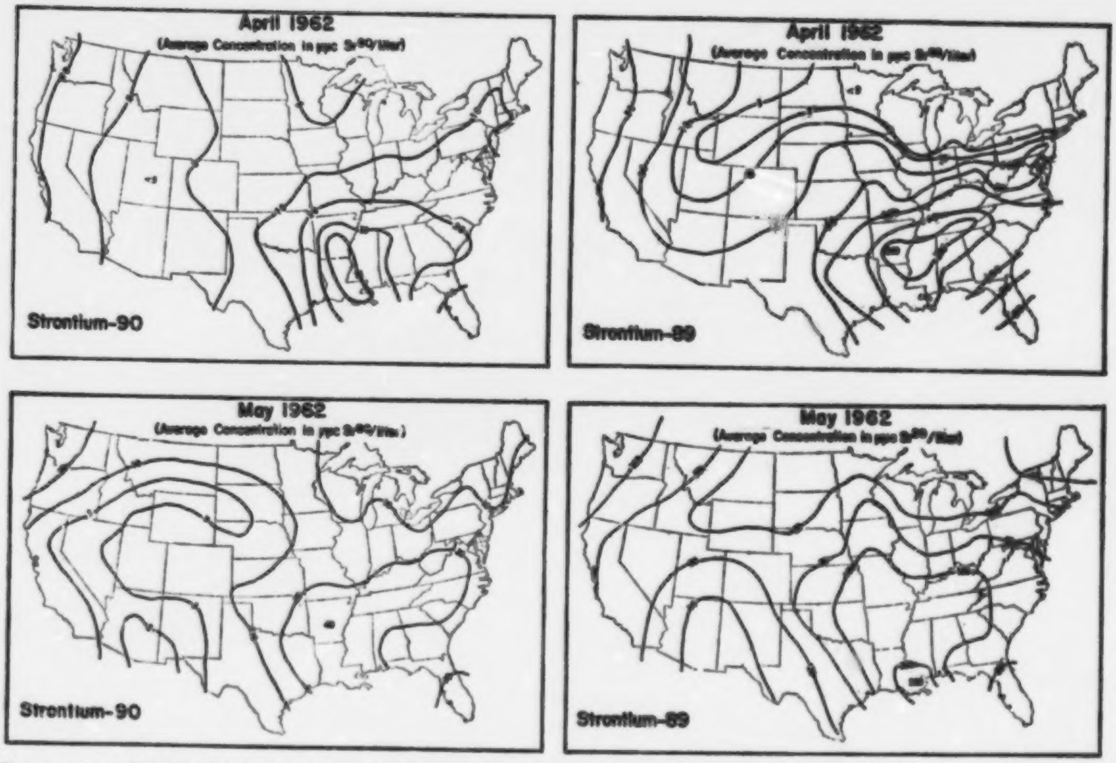
April 1962
(Average Concentration in μμc Sr^{90}/liter)
Strontium-90
April 1962
(Average Concentration in μμc Sr^{89}/liter)
Strontium-89
May 1962
(Average Concentration in μμc Sr^{90}/liter)
Strontium-90
May 1962
(Average Concentration in μμc Sr^{89}/liter)
Strontium-89

FIGURE 3.—GEOGRAPHICAL DISTRIBUTION OF STRONTIUM-90 AND STRONTIUM-89 CONCENTRATIONS DURING APRIL AND MAY 1962

May, however, the concentrations increased as the dairy cattle began to feed on pasture contaminated with relatively fresh fission products.

In April, iodine-131 concentrations in milk were less than the minimum detectable concentration. Iodine-131 concentrations increased to a maximum monthly average of 220 μμc/liter during May at Wichita, Kansas.

Tables 1 and 2 present summaries of all available analyses for April and May 1962. When a radionuclide is reported by the laboratory as being below the minimum detectable concentration, one-half of this value is used for calculating the monthly average. A similar procedure is used for the network average.

Strontium–90 in Canadian Dried Milk Products

RADIOACTIVE FALLOUT STUDY PROGRAM
Fourth Quarter 1961

Department of National Health and Welfare, Ottawa, Canada

In November 1955, radiochemical analyses of skim milk and buttermilk powders for strontium–90 concentrations were initiated by the Department of National Health and Welfare. Through the cooperation of the Marketing Division of the Canadian Department of Agriculture, dairy products inspectors collected four 1-pound samples of dried milk each month from each station (see figure 1) for the Radioactive Fallout Study Program. No precise control is maintained over the method of sample collection. Whether or not all samples are collected on the same day or if the sample is truly representative of the milk produced in a given area is not known.

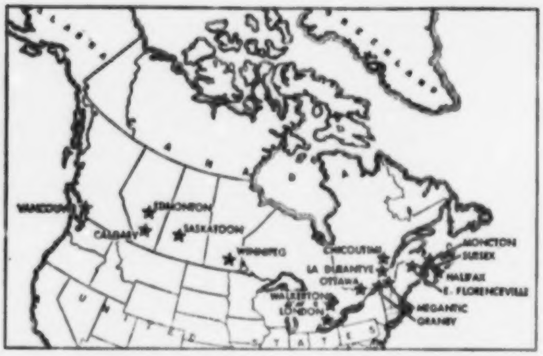

FIGURE 1.—CANADIAN DRIED MILK SAMPLING STATIONS

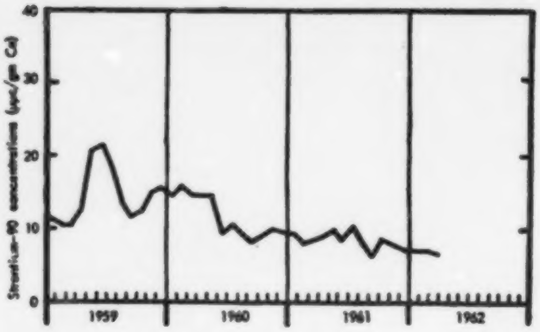

FIGURE 2.—AVERAGE STRONTIUM–90 CONCENTRATIONS IN CANADIAN DRIED MILK PRODUCTS

Because of uncertainties introduced by the method of sampling, the significance of differences between results from station-to-station and month-to-month cannot be precisely determined. It is possible, however, to consider all the results for a given period of time as being sufficiently random in selection to show any national trend when average values for such periods and all stations are plotted. These data are plotted in figure 2. It should be emphasized that average concentrations over a considerable period of time are more meaningful from the public health point of view than fluctuating monthly concentrations.

A detailed discussion of the sampling and radiochemical methodology employed may be found in the Department's publication (*1*).

Table 1 presents the results of measurements of strontium–90 in Canadian dried milk powder for the fourth quarter of 1961. This table was

TABLE 1.—STRONTIUM–90 IN CANADIAN DRIED MILK POWDER, 1961

[Concentrations in μμc/g Ca]

Station	Type of milk	October	November	December
Calgary	Skim milk	6.2	7.7	5.5
Chicoutimi [1]	Skim milk	13.3	[2] NS	NS
E. Florenceville	Skim milk	11.9	11.5	NS
Edmonton	Skim milk	6.9	5.9	6.8
Granby	Skim milk	12.4	9.4	11.7
Halifax	Skim milk	8.0	9.4	8.8
La Durantye	Skim milk	17.6	9.9	9.5
London	Skim milk	2.5	3.6	3.3
Megantic	Skim milk	11.7	10.8	12.3
Moncton	Buttermilk	7.2	10.9	8.4
Ottawa	Skim milk	4.3	4.8	5.0
Saskatoon	Buttermilk	5.1	6.5	6.1
Sussex	Skim milk	8.3	9.2	7.9
Vancouver	Skim milk	11.7	9.6	10.1
Walkerton	Skim milk	4.0	3.7	4.4
Winnipeg	Buttermilk	5.6	5.0	4.1
Average		8.5	7.9	7.3

[1] Chicoutimi stopped production. Milk powder samples from Mistassini on opposite shore of Lac St. Jean.

[2] NS indicates no sample received for the month.

taken from the "Quarterly Report of the Radioactive Fallout Monitoring Program," dated May 1962, published by the Radiation Protection Division of the Department of National Health and Welfare. [*Editor's note: For an approximate method to compare the Canadian powdered milk data in units of μμc/gm Ca to other milk data in units of μμc/liter, it can be assumed that milk has approximately 1 g Ca/liter of liquid milk. Therefore, the two units are roughly interchangeable.*]

Previous coverage in *Radiological Health Data:*

Period	*Issue*
January 1956–March 1960	*September 1960*
Second quarter 1960	*December 1960*
Third quarter 1960	*April 1961*
Fourth quarter 1960	*August 1961*
First quarter 1961	*December 1961*
Second quarter 1961	*February 1962*
Third quarter 1961	*May 1962*

REFERENCE

(*1*) Radiation Protection Division, Department of National Health and Welfare, Ottawa, Canada, "Preliminary Report on the Measurements of Radioactive Strontium in Canadian Milk Powder Samples," *CNHW (RP-1)*, (July 1958).

Radiostrontium in Milk[1]

January–February 1962

Health and Safety Laboratory
U.S. Atomic Energy Commission

The Health and Safety Laboratory (HASL) began monitoring liquid whole milk in New York City in 1954 for strontium-90 in order to estimate the dietary contribution from the ingestion of radiostrontium in milk. Subsequently, powdered milk monitoring was initiated at Perry, New York, and at Mandan, North Dakota. Liquid whole milk monitoring was started at Honolulu, Hawaii in August 1959.

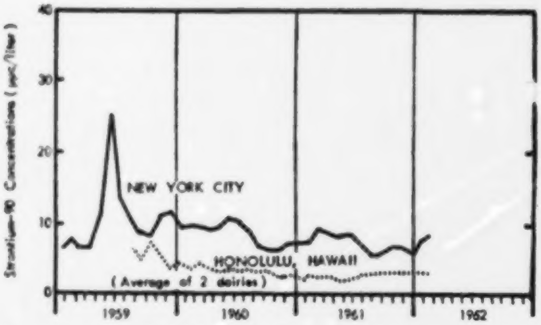

FIGURE 1.—STRONTIUM-90 IN LIQUID MILK SAMPLES

The New York City sample is a monthly composite of pasteurized milk purchased daily in quart containers at retail stores, representing 5 large dairies. The Honolulu sample is a monthly composite of pasteurized milk collected weekly, representing two dairies. The Mandan and Perry samples are monthly composites of powdered milk collected in 5-pound lots from plants at each city. The Mandan sample is powdered buttermilk used for cattle feed, while the Perry sample is powdered whole milk used for human consumption. The Honolulu data are of interest since the cows are on pasture throughout the year and soil analyses have shown strontium-90 concentrations in soils in

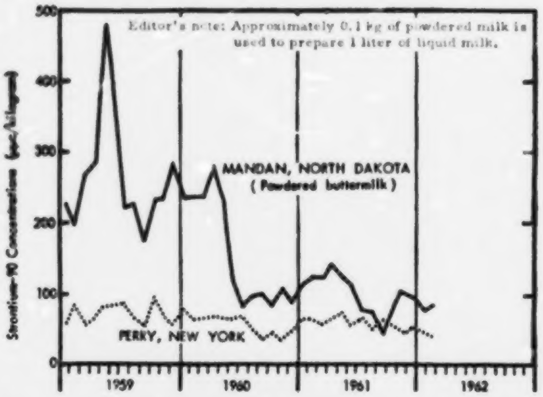

FIGURE 2.—STRONTIUM-90 IN POWDERED MILK SAMPLES

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[1] Data from USAEC Report "Fallout Program Quarterly Summary Report," HASL-127, July 1, 1962.

TABLE 1.—RADIOSTRONTIUM AND CALCIUM IN POWDERED MILK JANUARY–FEBRUARY 1962

Sampling station and period	g Ca/kg powder	$\frac{\mu\mu c\ Sr^{90}}{kg\ powder}$	$\frac{\mu\mu c\ Sr^{90}}{g\ Ca}$	$\frac{Sr^{89}}{Sr^{90}}$
Perry New York				
1959 Average			8.0	
1960 Average			6.5	
1961 Average			6.1	
1962 January	9.4	49	5.2	3
February	9.3	47	5.0	2
Mandan North Dakota (powdered buttermilk)				
1959 Average			25.7	
1960 Average			15.0	
1961 Average			9.1	
1962 January	11.0	85	7.7	2
February	11.3	88	7.8	2

Hawaii to be comparable with those in the New York area.[2]

Strontium–89 became measurable in September 1961, indicating that fresh fission products from the U.S.S.R. nuclear test series were being deposited. The Sr^{89}/Sr^{90} ratios are presented in tables 1 and 2, as are the calcium and strontium data for January and February 1962. The fluctuations of strontium–90 with time are shown in figures 1 and 2.

TABLE 2.—RADIOSTRONTIUM AND CALCIUM IN LIQUID MILK

January–February 1962

Sampling station and period	g Ca/liter	$\frac{\mu\mu c\ Sr^{90}}{liter}$	$\frac{\mu\mu c\ Sr^{90}}{g\ Ca}$	$\frac{Sr^{89}}{Sr^{90}}$
New York City				
1959 Average			11	
1960 Average			8.0	
1961 Average			6.6	
1962 January	1.3	7.3	5.7	[a]—
February	1.4	8.2	6.1	1
Honolulu Hawaii[b]				
1959 Average			5.0	
1960 Average			3.2	
1961 Average			2.5	
1962 January	1.2	3.0	2.6	10
February	1.0	2.8	2.8	12

[a] — indicates strontium-89 undectable.
[b] average of two dairies.

Previous coverage in *Radiological Health Data:*

Period	*Issue*
October 1959	*April 1960*
November 1959	*May 1960*
December 1959	*June 1960*
January–March 1960	*August 1960*
January–March 1960 (Honolulu)	*October 1960*
April–June 1960	*November 1960*
July–August 1960	*March 1961*
August–November 1960	*June 1961*
December 1960–April 1961	*December 1961*
May–July 1961	*March 1962*
August–December 1961	*June 1962*

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[2] USAEC Report No. HASL–90, p. 4, August 18, 1960.

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SECTION IV.—WATER

Radioactivity in Raw Surface Waters

NATIONAL WATER QUALITY NETWORK
March 1962

Division of Water Supply and Pollution Control, Public Health Service

The National Water Quality Network, operated in cooperation with State and local agencies and industrial organizations, commenced operations in October 1957. By the end of March 1962, 106 sampling stations were submitting water samples for analysis. These stations are located on major waterways used for public water supply, propagation of fish and wildlife, recreational purposes, and for agricultural, industrial, and other uses. Some of these stations are on interstate, coastal, and international boundary waters, and waters on which activities of the Federal Government may have an impact. Ultimately, a total of approximately 300 stations will be in operation. Radioactivity is not yet being reported for a few of the more recently established stations.

Samples of water are examined for chemical, physical, and biological quality insofar as these relate to pollution. Samples for some determinations are taken weekly, others monthly, and for some, continuous composite samples of 10 to 15 days are obtained.

Gross alpha and beta measurements are made on both suspended and dissolved solids (strontium-90 on the total solids only) in raw surface water samples. The levels of radioactivity associated with dissolved solids provide a rough measure of the levels which may be found in treated water, where such water treatment removes substantially all of the suspended matter. Naturally-occurring radioactive substances in the environment are the source of essentially all of the alpha activity. The contamination of the environment from man-made sources is the major contributor to the beta activity. It should be noted that with the cessation of weapons testing for a period of three years, the beta activity in most raw waters generally had approached a level attributable solely to natural sources. Natural beta activity can be two or three times the natural alpha activity based on the presence of the same nuclides. The resumption of nuclear weapons testing in the atmosphere has resulted in an increase in the radioactivity of raw surface waters.

For the first two years of the Network operations, beta determinations were made on weekly samples. Alpha determinations were reported generally on composites of more than one weekly sample. Since January 1959, a portion of each sample from all stations in the Network

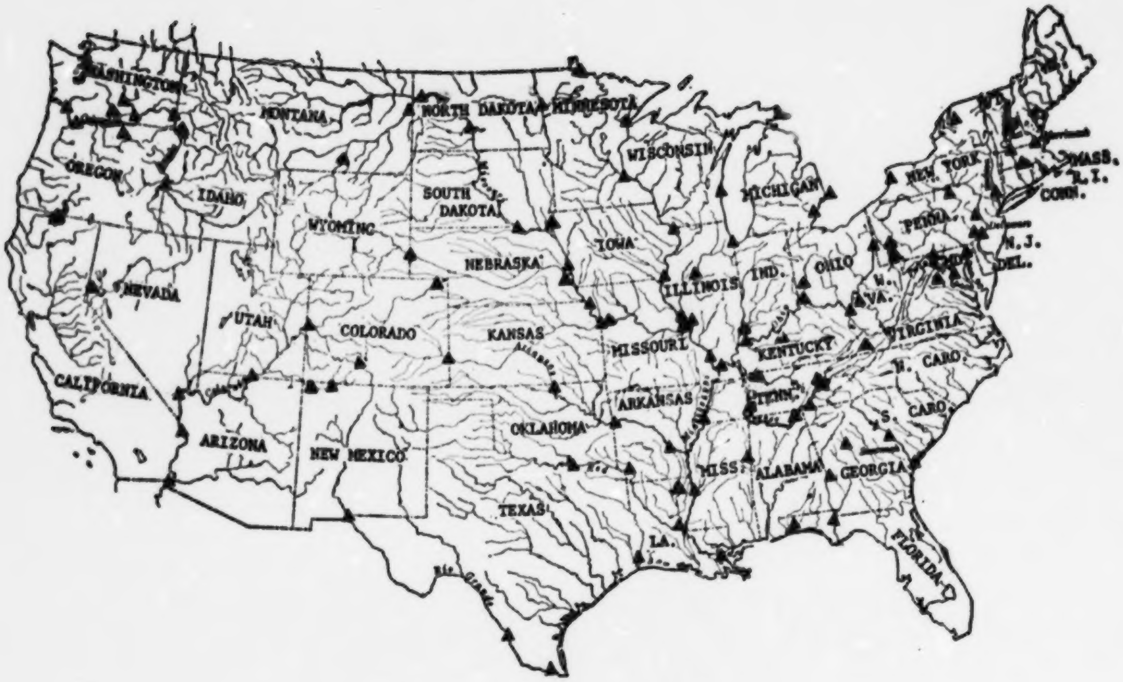

FIGURE 1.—NATIONAL WATER QUALITY NETWORK SAMPLING STATIONS, MARCH 1962

has been composited into a 3-month sample for measurement of strontium-90 concentration.

Beginning January 1, 1960, the frequency of beta determinations varied depending on the status of each particular station. For the first operating year of each new station, analyses were being conducted weekly. Weekly analyses were to be continued indefinitely for all stations which may be affected by waste discharges from nuclear installations. Semimonthly determinations (on composites of 2 or 3 weekly samples) were conducted for stations which still showed some beta activity above background. Monthly determinations (on composites of all samples received from a station during the month) were conducted on samples from streams where beta activity was at background levels.

Also in January 1960, the frequency of alpha determinations was changed. For the first operating year of each new station, analyses were done weekly. At some stations on the Colorado and Animas Rivers determinations were done on weekly samples or semimonthly on 2- or 3-week composites. The remainder of the stations were scheduled so that each made one gross alpha determination per month.

Following the resumption of nuclear weapons testing in the atmosphere by the U.S.S.R., the gross beta and alpha determination schedules were altered. Since September 1, 1961, gross beta determinations have been made on all samples collected (compositing weekly samples for monthly or semimonthly gross beta or alpha determinations will cease). Since October 1, 1961, gross alpha determinations have been made on one sample from each station each month, unless there is evidence of alpha activity in excess of background levels. In the latter instance, an alpha determination has been made on a weekly or biweekly basis, depending on what is considered the norm for a particular station.

The data reported in table 1 represent the average of all data reported for the periods indicated. The reported strontium-90 data are the results of determinations on 3-month composite samples for the quarter ending in the month shown.

BIBLIOGRAPHY

(1) *National Water Quality Network Annual Compilation of Data*, PHS Publication No. 663, Water Years, 1957–58, 1958–59, 1959–60. Public Health Service, Division of Water Supply and Pollution Control, Washington 25, D.C.

(2) "Report on National Water Quality Control Network," submitted by the Chief, Division of Radiological Health, PHS, before the Joint Committee on Atomic Energy Hearings on Fallout from Nuclear Weapons Tests, 1: 167-9 (May 1959).

(3) Setter, L. R., J. E. Regnier, and E. A. Diephaus, "Radioactivity of Surface Waters in the United States," *Journal of the American Wcter Works Association*, 51: 1377-92 (Nov. 1959).

(4) Straub, C. P., L. R. Setter, A. Goldin, and P. F. Hallbach, "Strontium-90 in Surface Waters," *Journal of the American Water Works Association*, 52: 756-68 (June 1960).

(5) Setter, L. R., and S. L. Baker, "Radioactivity of Surface Waters in the United States," *Radiological Health Data*, 1: 20-31 (October 1960).

(6) Straub, C. P., "Significance of Radioactivity Data," *Journal of the American Water Works Association*, 53: 704-3 (June 1961).

TABLE 1.—RADIOACTIVITY IN RAW SURFACE WATERS

[Average concentrations in μμc/liter]

Station	Quarter ending Dec. 31, 1961	March 1962					
	Strontium-90	Beta activity			Alpha activity		
	Total	Suspended	Dissolved	Total	Suspended	Dissolved	Total
Allegheny River: Pittsburgh, Pa.	—	25	19	44	0	0	0
Animas River: Cedar Hill, N. Mex.	—	74	32	106	12	7	19
Apalachicola River: Chattahoochie, Fla.	—	24	16	40	—	—	—
Arkansas River:							
Coolidge, Kansas	—	36	74	110	—	—	—
Ponca City, Okla.	—	17	12	29	0	1	1
Pendleton Ferry, Ark.	—	116	49	165	1	0	1
Big Horn River: Hardin, Mont.	—	53	21	74	8	4	12
Chattahoochie River:							
Columbus, Ga.	—	56	24	80	0	0	0
Atlanta, Ga.	0.3	19	10	29	0	0	0
Chena Slough: Fairbanks, Alaska	—	3	3	6	1	1	2
Clear Water River: East Lewiston, Idaho	0.3	18	12	30	1	0	1
Colorado River:							
Loma, Colo.	—	55	37	92	8	4	12
Page, Ariz.	—	167	43	210	39	10	49
Boulder City, Nev.	—	6	32	38	1	7	8
Parker Dam, Calif.	—	2	29	31	0	5	5
Yuma, Ariz.	—	3	61	64	0	8	8
Columbia River:							
Wenatchee, Wash.	—	5	10	15	0	1	1
Pasco, Wash.	—	53	558	611	0	1	1
Bonneville Dam, Oreg.	—	26	258	284	0	2	2
Clatskanie, Oreg.	—	21	132	153	0	1	1
McNary Dam, Oreg.	—	35	387	422	0	0	0
Connecticut River:							
Northfield, Mass.	—	7	23	30	0	0	0
Wilder, Vt.	—	9	20	29	0	0	0
Delaware River:							
Philadelphia, Pa.	—	22	21	43	0	0	0
Trenton, New Jersey	—	30	19	49	1	0	1
Martins Creek, Pa.	—	16	20	36	0	0	0
Escambia River: Century, Fla.	—	37	18	55	1	0	1
Great Lakes:							
Buffalo, N. Y.	0.8	13	22	35	0	0	0
Detroit, Mich.	—	12	16	28	0	0	0
Port Huron, Mich.	—	4	8	12	0	0	0
Milwaukee, Wis.	—	2	7	9	1	1	2
Sault Ste. Marie, Mich.	—	1	5	6	0	0	0
Gary, Ind.	0.1	12	12	24	0	0	0
Duluth, Minn.	—	10	2	12	0	0	0
Hudson River: Poughkeepsie, N. Y.	—	32	41	73	—	—	—
Illinois River: Peoria, Ill.	—	64	58	122	1	0	1
Kanawha River: Winfield Dam, W. Va.	—	29	10	39	0	0	0
Klamath River: Copco, Oreg.	—	30	36	66	0	0	0
Little Miami River: Cincinnati, Ohio	0.6	—	—	—	—	—	—
Mississippi River:							
St. Paul, Minn.	—	3	14	17	0	1	1
Dubuque, Iowa	—	27	27	54	0	1	1
Burlington, Iowa	—	84	24	108	0	1	1
E. St. Louis, Ill.	—	104	60	164	—	—	—
Cape Girardeau, Mo.	—	137	45	182	0	2	2
Delta, La.	—	67	33	100	—	—	—
New Orleans, La.	—	80	27	107	3	1	4
Vicksburg, Miss.	—	76	31	107	4	<1	4
Missouri River:							
Williston, N. Dak.	—	23	17	40	2	3	5
Bismarck, N. Dak.	—	16	18	34	0	4	4
Yankton, S. Dak.	—	23	30	53	0	7	7
Omaha, Nebr.	—	41	70	111	—	—	—
St. Joseph, Mo.	—	70	43	113	8	2	10
Kansas City, Kans.	—	151	47	198	—	—	—
St. Louis, Mo.	—	100	31	131	14	2	16
Monongahela River: Pittsburgh, Pa.	—	26	14	40	2	<1	2
North Platte River: Henry, Nebr.	—	7	49	56	1	30	31

TABLE 1.—RADIOACTIVITY IN RAW SURFACE WATERS—Continued

Station	Quarter ending Dec. 31, 1961	March 1962					
	Strontium-90	Beta activity			Alpha activity		
	Total	Suspended	Dissolved	Total	Suspended	Dissolved	Total
Ohio River:							
East Liverpool, Ohio	—	23	15	38	1	0	1
Huntington, W. Va	—	40	15	55	1	0	1
Cincinnati, Ohio	—	52	18	70	0	0	0
Louisville, Ky	—	62	17	79	4	<1	4
Evansville, Ind	—	84	22	106	3	0	3
Cairo, Ill	—	80	34	114	—	—	—
Ouachita River: Bastrop, La	—	45	52	97	1	0	1
Platte River: Plattsmouth, Nebr	—	22	44	66	0	6	6
Potomac River:							
Williamsport, Md	—	8	10	18	0	1	1
Great Falls, Md	—	4	10	14	—	—	—
Rainy River:							
Baudette, Minn	—	14	10	24	1	0	1
International Fls, Minn	—	1	8	9	0	0	0
Red River, South:							
Alexandria, La	—	101	35	136	—	—	—
Denison, Tex	—	15	31	46	0	1	1
Rio Grande River:							
Alamosa, Colo	—	11	22	33	<1	1	1
El Paso, Tex	—	44	14	58	3	4	7
Laredo, Tex	—	14	16	30	1	3	4
Brownsville, Tex	—	13	17	30	0	0	0
Roanoke River: John H. Kerr Resr. & Dam, Va	—	33	19	52	0	0	0
Sabine River: Ruliff, Tex	—	29	44	73	0	0	0
San Juan River: Shiprock, N. Mex	—	53	30	83	7	11	18
St. Lawrence River: Massena, N. Y	—	10	18	28	0	0	0
Schuylkill River: Philadelphia, Penn	—	19	30	49	1	0	1
Savannah River:							
North Augusta, S. C	—	24	13	37	—	—	—
Port Wentworth, Ga	—	36	54	90	—	—	—
Shenandoah River: Berryvilla, Va	0.2	32	11	43	1	0	1
Ship Creek: Anchorage, Alaska	—	2	6	8	0	0	0
Snake River:							
Wawawi, Wash	—	16	16	32	3	1	4
Payette, Idaho	—	15	27	42	1	3	4
South Platte River: Julesburg, Colo	—	37	71	108	2	33	35
Susquehanna River:							
Sayre, Pa	—	26	33	59	0	0	0
Conowingo, Md	—	41	18	59	—	—	—
Tennessee River:							
Lenoir City, Tenn	—	26	22	48	1	0	1
Chattanooga, Tenn	0.5	14	24	38	—	—	—
Bridgeport, Ala	—	10	19	29	0	0	0
Pickwick Landing, Tenn	—	28	41	69	<1	0	<1
Tombigbee River: Columbus, Miss	0.2	27	19	46	0	0	0
Truckee River: Farad, Calif	—	21	32	53	0	0	0
Verdigris River: Nowata, Okla	—	147	61	208	3	0	3
Yakima River: Richland, Wash	—	5	8	13	0	1	1
Yellowstone River: Sidney, Mont	—	29	32	61	18	5	23

Radiostrontium in Tap Water[1]

Health and Safety Laboratory
U.S. Atomic Energy Commission

The Health and Safety Laboratory (HASL) has been assaying monthly composites of daily samples of tap water for strontium–90 at New York City since August 1954 and at Richmond, California since April 1958. Strontium–89 has been determined since September 1961.

The strontium–90 concentrations and strontium–89/strontium–90 ratios from January through April 1962 are presented in table 1, while the strontium–90 concentrations through April 1962 are plotted in figure 1. Data prior to 1958 appear in an earlier HASL report.[2]

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[1] U.S. Atomic Energy Commission, *Fallout Program Quarterly Summary Report, HASL–127*, Office of Technical Services, Department of Commerce, Washington 25, D.C. (July 1, 1962), price $3.00.

[2] U.S. Atomic Energy Commission, *Environmental Contamination from Weapon Tests, HASL–42*, Office of Technical Services, Department of Commerce, Washington 25, D.C. (October 1962), price $3.50.

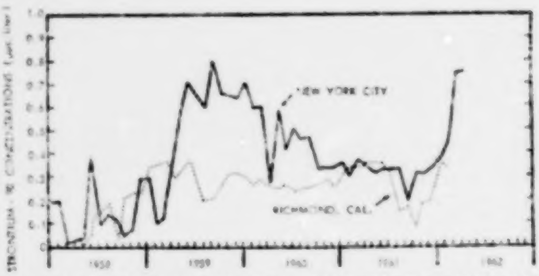

FIGURE 1.—STRONTIUM-90 CONCENTRATIONS IN TAP WATER

Comments

The results presented in figure 1 show that prior to 1961 the strontium-90 concentrations in tap water from Richmond were lower than those in tap water from New York City, which is the usual east-west relationship. The levels in both cities were about the same for the first half of 1961, which may be due to the similarities between fallout rates in these areas.[3] After January 1962, the strontium-90 concentrations increased sharply in both cities to 1959 levels, with the usual east–west relationship again being demonstrated. The strontium–89/strontium–90 ratios indicate injection of fresh fission products, including strontium–89 at Richmond. It is evident from these data that debris from the U.S.S.R. testing series is entering the water supply systems and is mixing with the older debris already present.

TABLE 1.—RADIOSTRONTIUM IN TAP WATER

Month	New York City		Richmond, California	
	Sr^{90} (μμc/liter)	Sr^{89}/Sr^{90}	Sr^{90} (μμc/liter)	Sr^{89}/Sr^{90}
1959 Average	0.40		0.29	
1960 Average	0.47		0.26	
1961 Average	0.32		0.25	
1962 January	0.37	8.3	0.35	14
February	0.42	5.9	0.31	11
March	0.73	3.1		
April	0.74	7.7		

Previous coverage in *Radiological Health Data*:

Period	*Issue*
September 1959	*April 1960*
December 1959	*July 1960*
December 1959 and first quarter 1960	*August 1960*
Second quarter 1960	*December 1960*
Third quarter 1960	*April 1961*
Fourth quarter 1960	*September 1961*
First quarter 1961	*December 1691*
Second quarter 1961	*March 1962*
Third and fourth quarters 1961	*June 1962*

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[3] U.S. Atomic Energy Commission, *Fallout Program Quarterly Summary Report, HASL–122*, Office of Technical Services, Department of Commerce, Washington 25, D.C. (April 1, 1962), price $3.00.

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SECTION V.—OTHER DATA

Mid-May Iodine–131 Fallout in the Midwest

U.S. Weather Bureau, Department of Commerce, and
Division of Radiological Health,
Public Health Service

Iodine–131 attributed to the Christmas Island tests was first observed in pasteurized milk in some of the midwestern States during the second and third weeks of May 1962. Since that time, additional data and information have been secured from the U.S. Weather Bureau and the Radiation Surveillance Network (RSN) which show some correlation with the occurrence of iodine–131 in milk.

Fission Product Activity in Air

Fission product activity of airborne particulates is monitored continuously at about 70 stations by the RSN. To adequately describe fission product activity, both gross beta concentration and age of fission products are necessary. (Refer to page 311 for the method of determination of concentration and age of fission products.) The upper two maps on each page of figure 1 give a geographical day-by-day progression (May 8–15) of the fission product gross beta concentrations of particulates in surface air and the extrapolated age of fission products in days after formation.

The age shown by the age contours is an apparent or average age. For example, an apparent age of 60 days only 15 days after the first test of the series indicates a mixture of fresh products with some of the older activity from the 1961 U.S.S.R. tests.

Precipitation

Precipitation data are presented in the lower maps of figure 1. The numbers inside the rectangles represent the extrapolated age of fission products in days and the total beta activity deposited by rainfall during a 24 hour period as determined by RSN. The shaded areas represent depth of precipitation in millimeters as measured by the Weather Bureau during a 24–hour period ending 1:00 a.m., EST, on the same date. The fronts and the high and low pressure centers are shown for 1:00 a.m.[1]

Although the blank areas on the precipitation maps indicate no precipitation, it is possible that some of these areas may have received small local showers that fell between the coarse network of Weather Bureau stations. Several such showers were detected by radar and are so indicated in table 1.

Iodine–131 in Milk

Iodine–131 concentrations in composited pasteurized milk are monitored in 61 cities

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[1] U.S. Department of Commerce, Weather Bureau, *Daily Weather Map* (May 8–15, 1962).

TABLE 1.—U. S. WEATHER BUREAU RAINFALL DATA

[Depth of rainfall in mm]

Station	1962 May 4	May 5	May 6	May 7	May 8	May 9	May 10	May 11	May 12	May 13	May 14	May 15	May 16
Little Rock, Ark.	0	0	0	[a]T	0	0	0	0	0	0	0	0	0
Denver, Colo.	0	0	[b]0	T	0	0	0	0	0	0	0	0	0
Chicago, Ill.	0	0	4.0	0	19	0	4.7	2.5	0	17	0	0	0
Des Moines, Iowa	0	0	6.0	0	40	0	T	0	0	0	T	0	0
Wichita, Kans.	T	0	0	0	6	0	[b]0	[a]T	0	0	0	0	0
Minneapolis, Minn.	T	0.5	0	0	3.5	0	T	T	60	24	1.0	0	10
Kansas City, Mo.	0	0	0	0	0	4.8	0	T	0	0	0	0	0
St. Louis, Mo.	0.2	0	0	0.5	2.0	0	0	19	0	0	0	0	0
Syracuse, N. Y.	0.2	0	0	6.5	0	1.5	0	0	0	0	3.5	0	0
Cincinnati, Ohio	0	0	0	T	0.2	3.3	T	12	0	0	0	0	0
Chattanooga, Tenn.	0	0	0	0	0	0	T	0	0	0	0	0	0
Charleston, W. Va.	0	0	0	0	3.8	0	0	0	0	0	1.0	0	0

[a] T indicates trace.

[b] Although no measureable rain was reported, radar echoes indicated precipitation in the vicinity.

TABLE 2.—IODINE-CONCENTRATIONS IN PASTEURIZED MILK, AT SELECTED STATIONS[1]

[Concentrations in μμc/liter]

Milk sampling station / Date May 1962	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Little Rock, Ark. Denver, Colo. Des Moines, Iowa			<10 <10				30			45 300						<10	40 <10 60				75
Wichita, Kans. Louisville, Ky. Minneapolis, Minn.	<10			<10		670		660 20			200		215		165 30			170		230	
Kansas City, Mo. St. Louis, Mo. Syracuse, N. Y.		15	45	<10					80		605			50			<10	180			75
Cincinnati, Ohio Chattanooga, Tenn. Charleston, W. Va.			<10 <10	<10				30		50	40				<10		20 50				

[1] Data from Pasteurized Milk Monitoring Network, compiled by the Radiation Surveillance Center.

by the Public Health Service Milk monitoring Network (see page 336). The milk collection areas (milksheds) for 11 of the midwestern sampling points are shown in figure 2, and the iodine-131 concentrations in milk from the same locations during the second and third weeks of May are presented in table 2.

More detailed milk sampling data within the midwest region for the May 8–15 period were obtained from the St. Louis County Health Department's Market Milk Study. These data are of particular interest to show possible relations to the meteorological and other data for the St. Louis milk collection area, since the milk samples are composited identically to the PHS Pasteurized Milk Monitoring Program sample for St. Louis and are collected daily. Table 3 and figure 3 present the daily concentrations of iodine-131 in St. Louis for May 8–28 and an estimated average precipitation in the St. Louis milk collection area based on the *Daily Weather Maps.*

Interpretation

Laboratory examination of gross beta concentrations in air* (see concentration contour maps in figure 1) shows no evidence of any unusual event which could be associated with the appearance of iodine in milk, in the central portion of the United States during the second week of May. However, age of fission product analysis* of the RSN air filter samples permits the development of fission product age contour maps (figure 1) which point out a more revealing picture. Here, the intrusion of fresh fission products as shown on these maps coincides with the area where relatively high levels of iodine–

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* A minimum of 10 days after date of air filter removal is required for the gross beta concentration and age of fission product determinations.

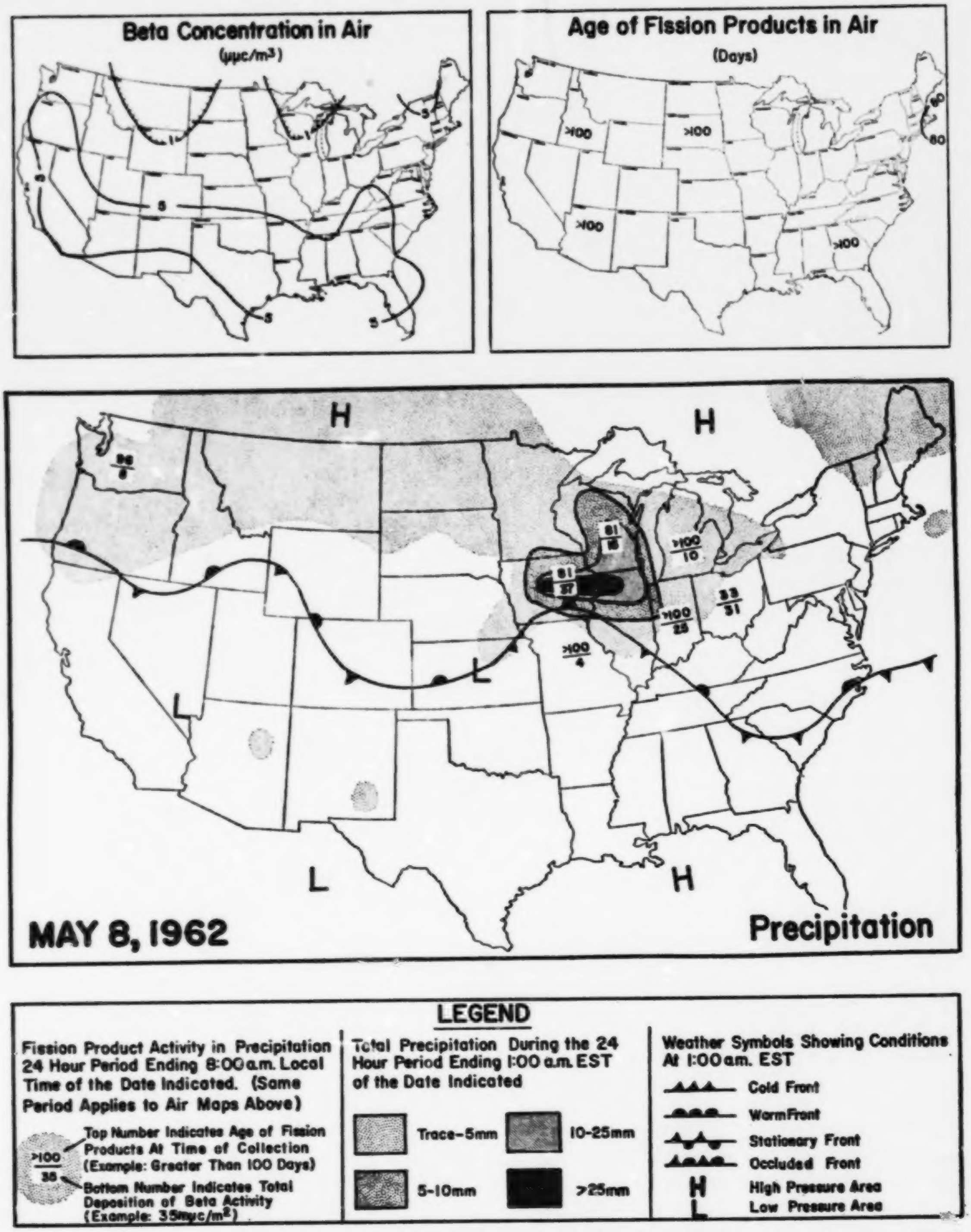

Beta Concentration in Air
(μμc/m³)
1
3
5
5
5
5
5
Age of Fission Products in Air
(Days)
>100
>100
>100
>100
60
60
H
H
H
L
L
L
96/8
81/15
81/37
>100/10
>100/25
33/31
>100/4
MAY 8, 1962
Precipitation
LEGEND
Fission Product Activity in Precipitation 24 Hour Period Ending 8:00 a.m. Local Time of the Date Indicated. (Same Period Applies to Air Maps Above)
>100/35
Top Number Indicates Age of Fission Products At Time of Collection (Example: Greater Than 100 Days)
Bottom Number Indicates Total Deposition of Beta Activity (Example: 35μμc/m²)
Total Precipitation During the 24 Hour Period Ending 1:00 a.m. EST of the Date Indicated
Trace-5mm
10-25mm
5-10mm
>25mm
Weather Symbols Showing Conditions At 1:00 a.m. EST
Cold Front
Warm Front
Stationary Front
Occluded Front
H High Pressure Area
L Low Pressure Area

FIGURE 1.—COMPARISON OF DAILY FISSION PRODUCT CONCENTRATION AND AGE IN AIR TO TOTAL PRECIPITATION

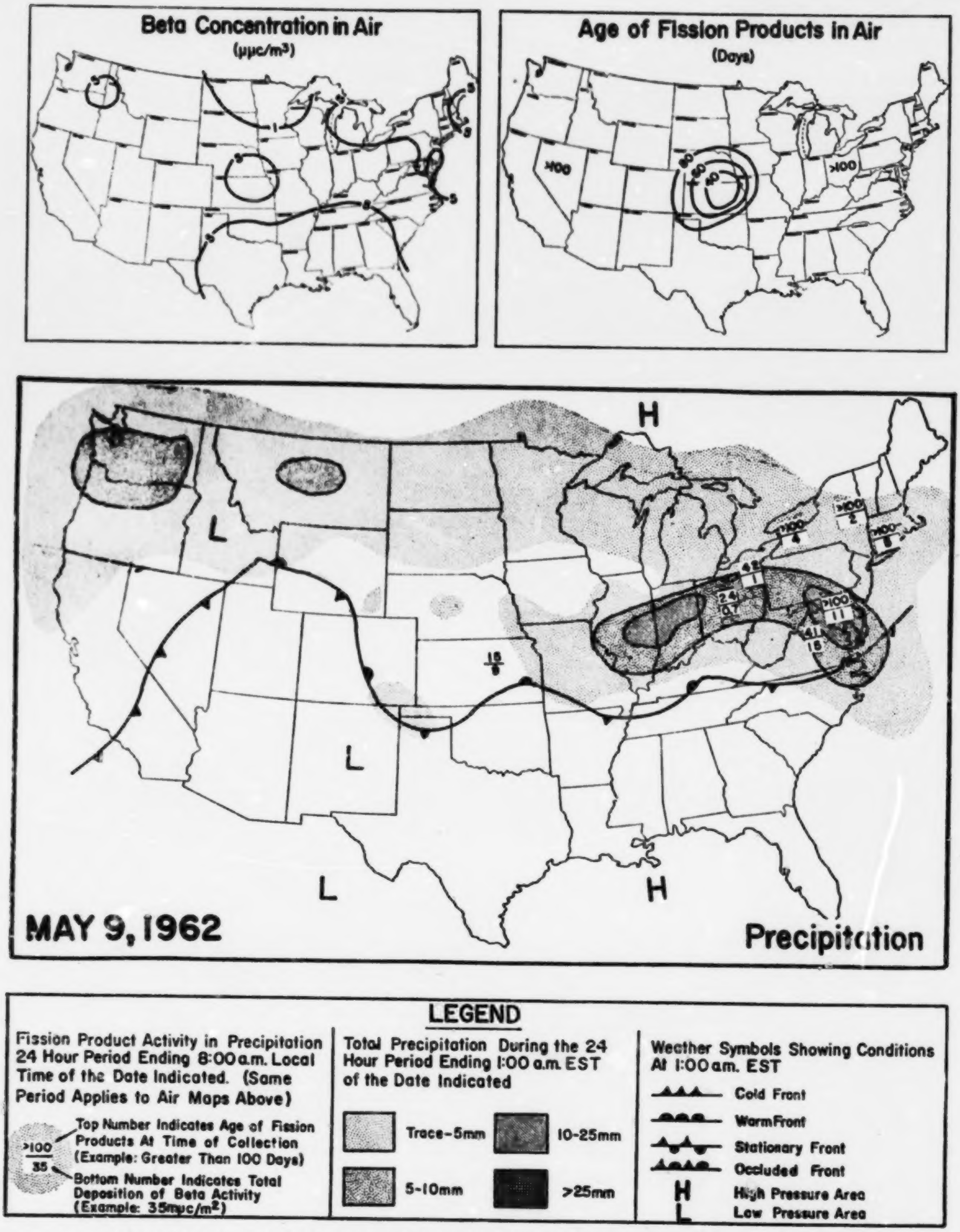

Beta Concentration in Air
(μμc/m³)
Age of Fission Products in Air
(Days)
>100
>100
H
L
L
L
H
MAY 9, 1962
Precipitation
LEGEND
Fission Product Activity in Precipitation 24 Hour Period Ending 8:00 a.m. Local Time of the Date Indicated. (Same Period Applies to Air Maps Above)
Top Number Indicates Age of Fission Products At Time of Collection (Example: Greater Than 100 Days)
>100
35
Bottom Number Indicates Total Deposition of Beta Activity (Example: 35μμc/m²)
Total Precipitation During the 24 Hour Period Ending 1:00 a.m. EST of the Date Indicated
Trace-5mm
10-25mm
5-10mm
>25mm
Weather Symbols Showing Conditions At 1:00 a.m. EST
Cold Front
Warm Front
Stationary Front
Occluded Front
H High Pressure Area
L Low Pressure Area

FIGURE 1.—COMPARISON OF DAILY FISSION PRODUCT CONCENTRATION AND AGE IN AIR TO TOTAL PRECIPITATION—Continued

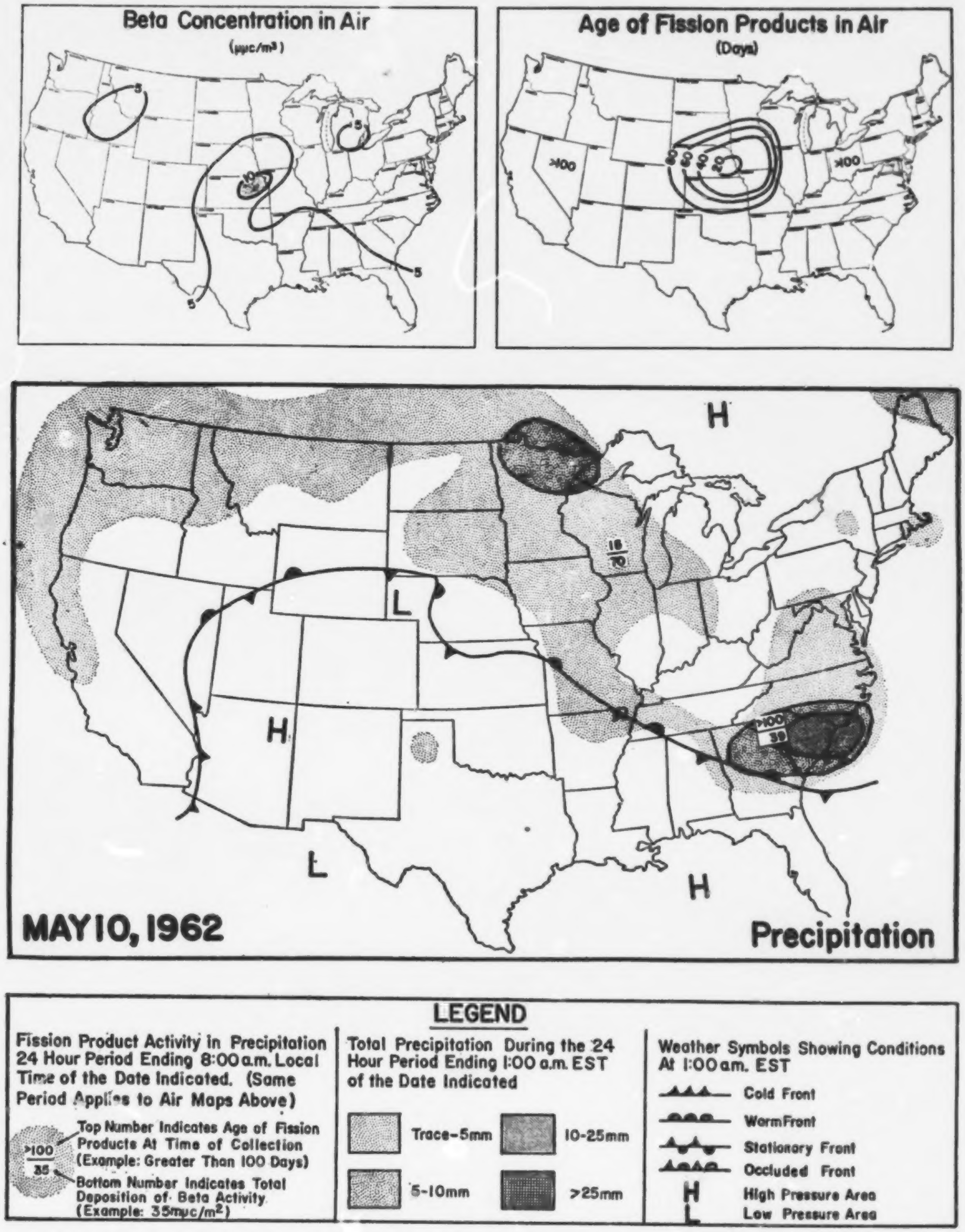
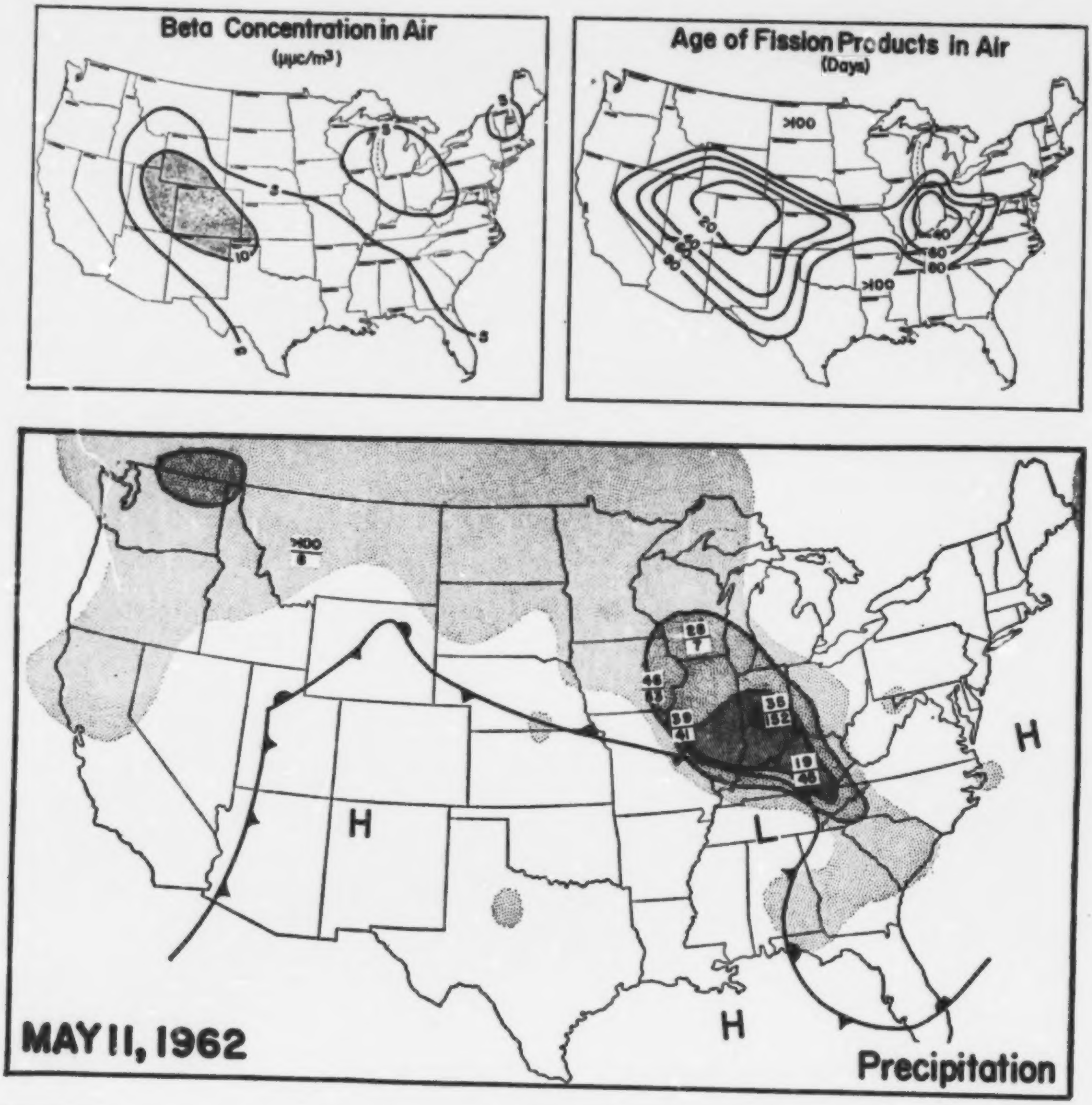

Beta Concentration in Air
(μμc/m³)
5
5
10
5
5
Age of Fission Products in Air
(Days)
>100
80
60
40
20
>100
H
L
H
L
H
16
70
>100
39
MAY 10, 1962
Precipitation
LEGEND
Fission Product Activity in Precipitation 24 Hour Period Ending 8:00 a.m. Local Time of the Date Indicated. (Same Period Applies to Air Maps Above)
>100
35
Top Number Indicates Age of Fission Products At Time of Collection (Example: Greater Than 100 Days)
Bottom Number Indicates Total Deposition of Beta Activity (Example: 35mμc/m²)
Total Precipitation During the 24 Hour Period Ending 1:00 a.m. EST of the Date Indicated
Trace-5mm
10-25mm
5-10mm
>25mm
Weather Symbols Showing Conditions At 1:00 a.m. EST
Cold Front
Warm Front
Stationary Front
Occluded Front
H High Pressure Area
L Low Pressure Area

FIGURE 1.—COMPARISON OF DAILY FISSION PRODUCT CONCENTRATION AND AGE IN AIR TO TOTAL PRECIPITATION—Continued

150<


Beta Concentration in Air

(μμc/m³)

Age of Fission Products in Air

(Days)

MAY 11, 1962

Precipitation

LEGEND

Fission Product Activity in Precipitation 24 Hour Period Ending 8:00 a.m. Local Time of the Date Indicated. (Same Period Applies to Air Maps Above)

$\frac{>100}{35}$ Top Number Indicates Age of Fission Products At Time of Collection (Example: Greater Than 100 Days) Bottom Number Indicates Total Deposition of Beta Activity (Example: 35mμc/m²)

Total Precipitation During the 24 Hour Period Ending 1:00 a.m. EST of the Date Indicated

░ Trace-5mm

▒ 10-25mm

▒ 5-10mm

▓ >25mm

Weather Symbols Showing Conditions At 1:00 a.m. EST

▲▲▲ Cold Front

⌓⌓⌓ Warm Front

▲⌓▲ Stationary Front

▲⌓▲⌓ Occluded Front

H High Pressure Area

L Low Pressure Area

FIGURE 1.—COMPARISON OF DAILY FISSION PRODUCT CONCENTRATION AND AGE IN AIR TO TOTAL PRECIPITATION—Continued

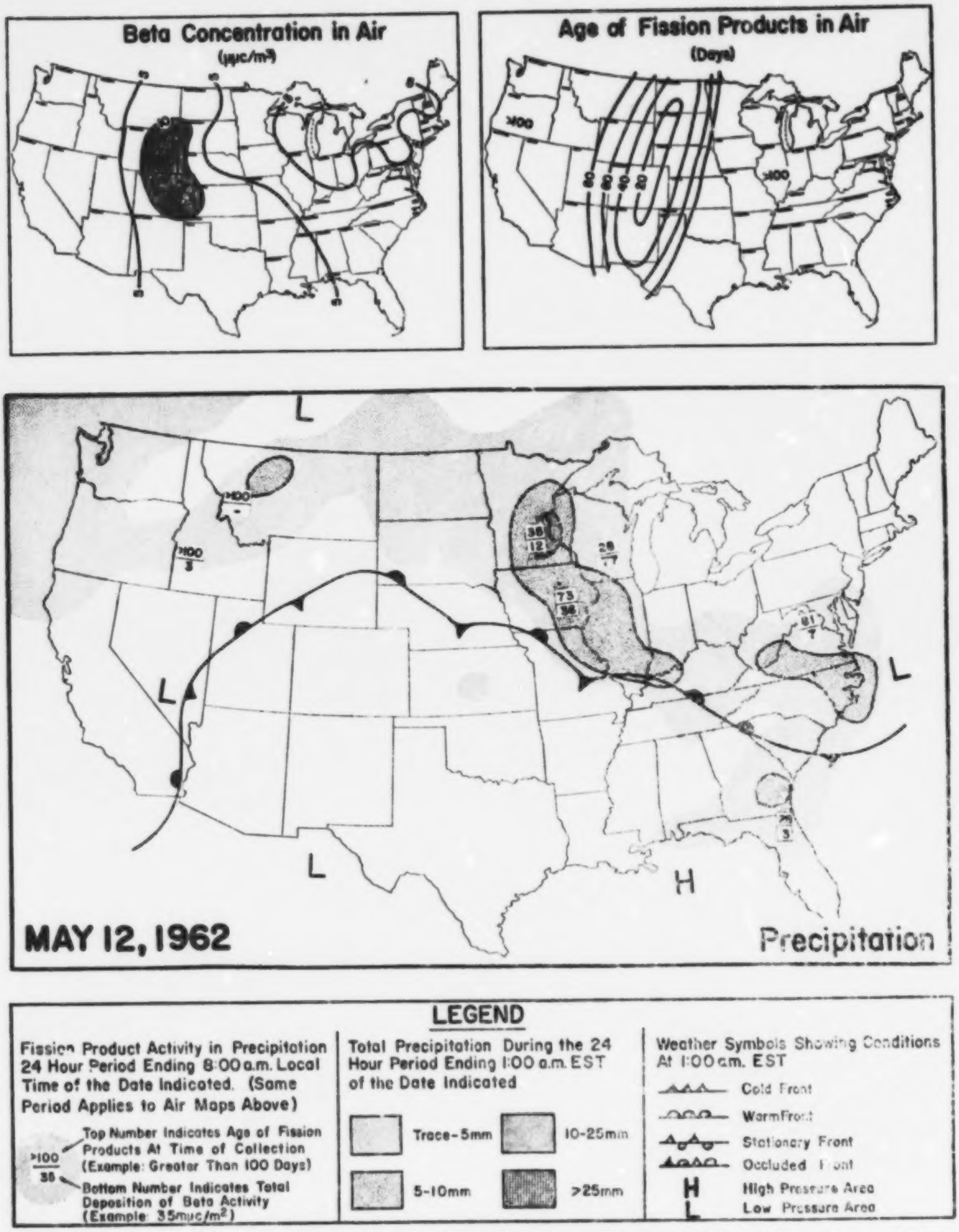
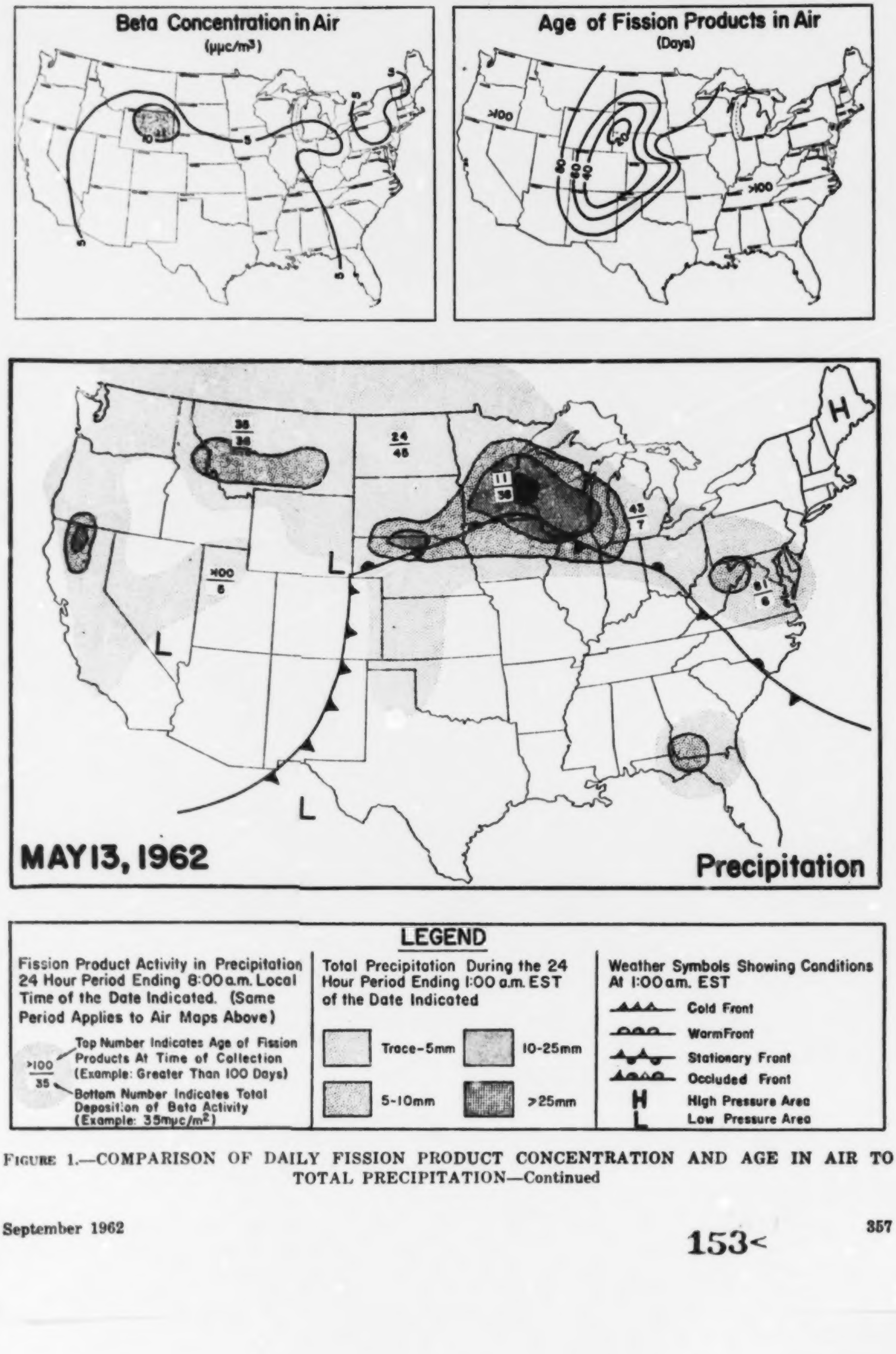

Beta Concentration in Air
(μμc/m³)
Age of Fission Products in Air
(Days)
>100
>100
>100
>100
3
38
12
28
7
73
38
81
7
3
L
L
L
L
H
MAY 12, 1962
Precipitation
LEGEND
Fission Product Activity in Precipitation 24 Hour Period Ending 8:00 a.m. Local Time of the Date Indicated. (Same Period Applies to Air Maps Above)
>100
35
Top Number Indicates Age of Fission Products At Time of Collection (Example: Greater Than 100 Days)
Bottom Number Indicates Total Deposition of Beta Activity (Example: 35μμc/m²)
Total Precipitation During the 24 Hour Period Ending 1:00 a.m. EST of the Date Indicated
Trace-5mm
10-25mm
5-10mm
>25mm
Weather Symbols Showing Conditions At 1:00 a.m. EST
Cold Front
Warm Front
Stationary Front
Occluded Front
H High Pressure Area
L Low Pressure Area

FIGURE 1.—COMPARISON OF DAILY FISSION PRODUCT CONCENTRATION AND AGE IN AIR TO TOTAL PRECIPITATION—Continued



Beta Concentration in Air (μμc/m³)

Age of Fission Products in Air (Days)

MAY 13, 1962

Precipitation

5
10
5
5
5
5
>100
80
60
40
20
>100
38
36
24
45
11
38
45
7
>100
6
61
6
H
L
L
L

LEGEND
Fission Product Activity in Precipitation 24 Hour Period Ending 8:00 a.m. Local Time of the Date Indicated. (Same Period Applies to Air Maps Above)
>100
35
Top Number Indicates Age of Fission Products At Time of Collection (Example: Greater Than 100 Days)
Bottom Number Indicates Total Deposition of Beta Activity (Example: 35mμc/m²)
Total Precipitation During the 24 Hour Period Ending 1:00 a.m. EST of the Date Indicated
Trace-5mm
10-25mm
5-10mm
>25mm
Weather Symbols Showing Conditions At 1:00 a.m. EST
Cold Front
Warm Front
Stationary Front
Occluded Front
H High Pressure Area
L Low Pressure Area

FIGURE 1.—COMPARISON OF DAILY FISSION PRODUCT CONCENTRATION AND AGE IN AIR TO TOTAL PRECIPITATION—Continued

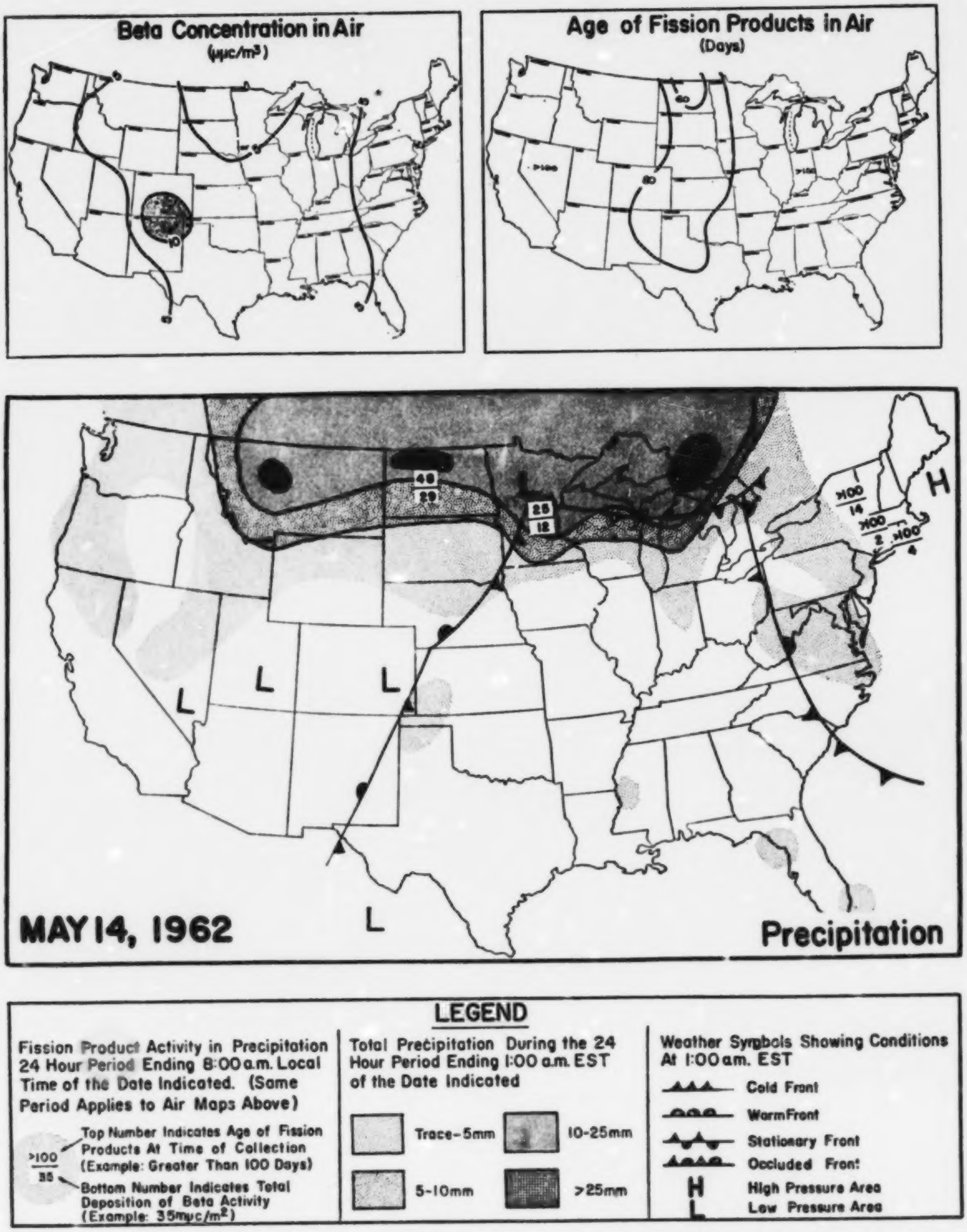

Beta Concentration in Air
(µµc/m³)
10
Age of Fission Products in Air
(Days)
60
80
>100
>100
48
29
28
12
>100
14
>100
2
>100
4
H
L
L
L
L
L
MAY 14, 1962
Precipitation
LEGEND
Fission Product Activity in Precipitation 24 Hour Period Ending 8:00 a.m. Local Time of the Date Indicated. (Same Period Applies to Air Maps Above)
>100
35
Top Number Indicates Age of Fission Products At Time of Collection (Example: Greater Than 100 Days)
Bottom Number Indicates Total Deposition of Beta Activity (Example: 35mµc/m²)
Total Precipitation During the 24 Hour Period Ending 1:00 a.m. EST of the Date Indicated
Trace-5mm
5-10mm
10-25mm
>25mm
Weather Symbols Showing Conditions At 1:00 a.m. EST
Cold Front
Warm Front
Stationary Front
Occluded Front
H High Pressure Area
L Low Pressure Area

FIGURE 1.—COMPARISON OF DAILY FISSION PRODUCT CONCENTRATION AND AGE IN AIR TO TOTAL PRECIPITATION—Continued

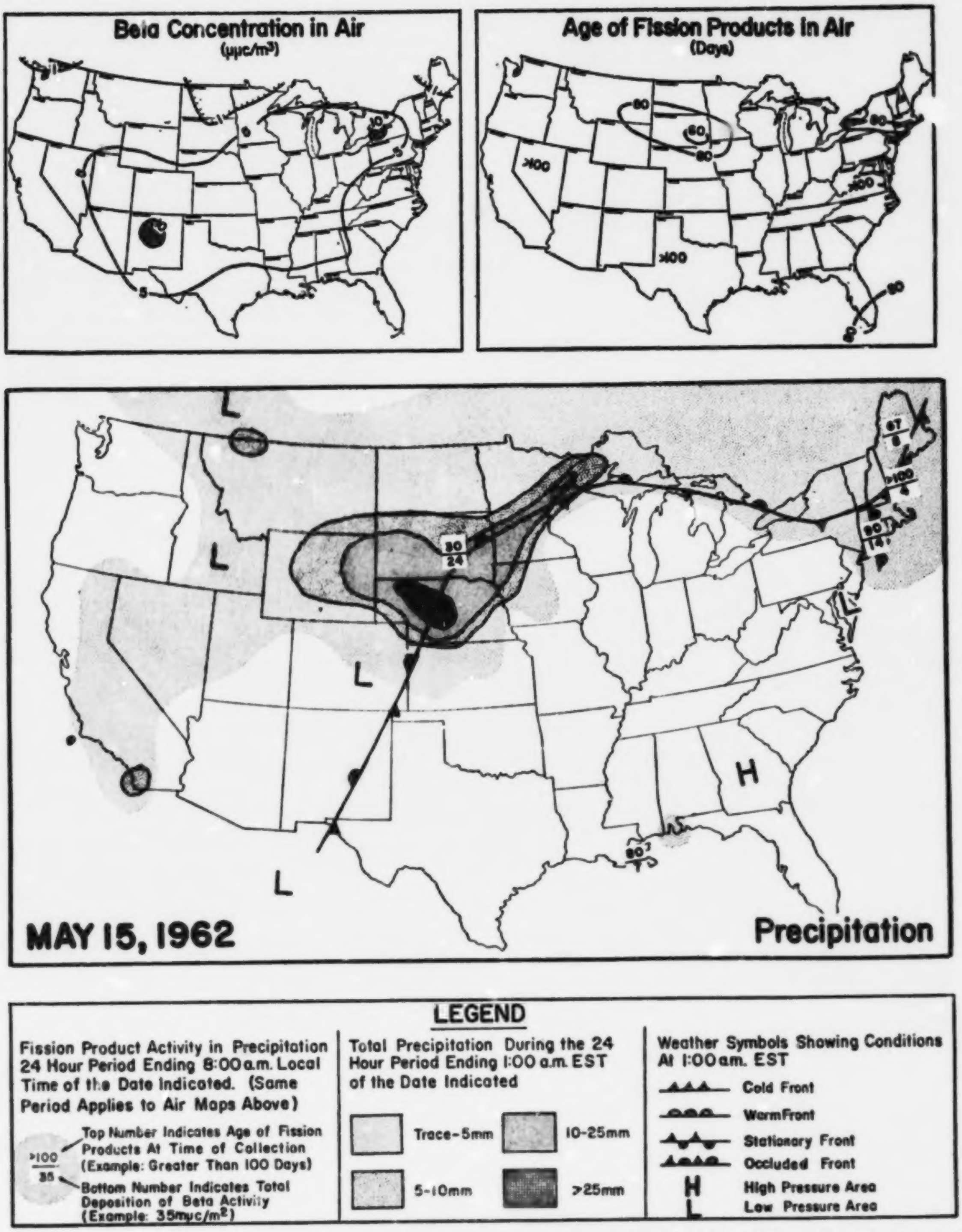

Beta Concentration in Air
(μμc/m³)
5
10
Age of Fission Products in Air
(Days)
80
60
>100
L
H
80
24
67
8
>100
4
90
14
MAY 15, 1962
Precipitation
LEGEND
Fission Product Activity in Precipitation 24 Hour Period Ending 8:00 a.m. Local Time of the Date Indicated. (Same Period Applies to Air Maps Above)
>100
35
Top Number Indicates Age of Fission Products At Time of Collection (Example: Greater Than 100 Days)
Bottom Number Indicates Total Deposition of Beta Activity (Example: 35mμc/m²)
Total Precipitation During the 24 Hour Period Ending 1:00 a.m. EST of the Date Indicated
Trace-5mm
10-25mm
5-10mm
>25mm
Weather Symbols Showing Conditions At 1:00 a.m. EST
Cold Front
Warm Front
Stationary Front
Occluded Front
H High Pressure Area
L Low Pressure Area

FIGURE 1.—COMPARISON OF DAILY FISSION PRODUCT CONCENTRATION AND AGE IN AIR TO TOTAL PRECIPITATION—Continued

TABLE 3.—IODINE-131 IN MARKET MILK IN ST. LOUIS AND PRECIPITATION IN THE ST. LOUIS COLLECTION AREA[a]

1962	Estimated precipitation		I^{131} in milk (μμc/liter)
	Percent of area with rain	Average mm of ppt.	
May 8	30%	7	[b]ND
9	80%	5	9
10	80%	2	ND
11	70%	10	ND
12	70%	5	6
13	20%	2	
14	0%	0	32
15	5%	Trace	49
16	10%	Trace	74
17	0%	0	66
18	30%	1	76
19	0%	0	58
20	20%	15	—
21	20%	Trace	38
22	40%	Trace	46
23	60%	3	37
24	10%	Trace	26
25	30%	Trace	17
26	100%	5	45
27	80%	5	—
28	100%	2	30

[a] Milk sampling by the St. Louis County Health Department; precipitation estimated from Daily Weather Maps U.S. Weather Bureau.

[b] ND indicates non-detectable.

[c] — indicates no sample.

131 were observed in milk. Because of its short half life (8 days), iodine-131 from fallout is associated only with relatively fresh fission products.

Because fresh fission product activity in precipitation can usually be demonstrated in the chain of events for transmitting iodine-131 to milk, careful attention was directed to the precipitation and other meteorological data in the vicinities of various cities where radioiodine was found in milk. It can be observed that some of the areas where iodine-131 was detected had heavy rains, but others, notably Wichita, Kansas, apparently had little or no rain at all, based on the *Daily Weather Maps*.

One possible explanation for this apparent anomaly is suggested in the following comments submitted by Dr. Lester Machta, Chief, Meteorological Research Projects Branch, U.S. Weather Bureau.

> ". . . It is the nature of thundershowers that they are localized and the reports of rainfall at the Weather Bureau Airport rain gauge may not reflect the correct amount or even the presence of rainfall at the pasture fields. . . . Radar, however, does see all rainshowers within its range and in many instances it is clear from the radar reports that there must have been rain between the coarse network of reporting raingauges. . . . The Weather Bureau is currently reporting, on an experimental basis, the tops of radar echoes. Inspection of these cloud top reports indicates that during the period of 10–14 May, some of the thunderclouds rose to heights of 50,000 feet or more. At the same time, the officially reported height of the tropopause was about 40,000 ± 2,000 feet. Thus, it may be concluded that even if radioactive debris were entirely confined to the stratosphere (which at present is not confirmed), it is entirely possible that precipitation could have brought down material from within the stratosphere.
>
> "Debris was present in the lower stratosphere, between 50,000 and 60,000 feet as early as 8 May (and possibly earlier) over the U.S. between 31 and 42°N from information provided by the Stardust program of the Defense Atomic Support Agency. Preliminary dating of the debris found in these stratospheric samples suggested early May (possibly the 4th) as the time of origin. Thus, it is known that there was debris in the lower stratosphere at the probable time of the penetration of this level by the thunderclouds."

Dr. Machta also discussed the possible origin of the radioactive debris as follows:

> "The origin of the debris cannot be identified with absolute confidence. Normally, if a meteorological trajectory coincides with the arrival of debris from an announced detonation, this is accepted as proof of origin in the absence of radiochemical dating. This is not possible because the only announced nuclear tests since April 25, 1962 took place at Christmas Island and there are insufficient weather data to be able to compute a trajectory of the air masses carrying the nuclear debris from Christmas Island. However, during the period from 6–7 May through 15 May there was a flow of air in the upper troposphere and lower stratosphere in the western part of the U.S. from the west-southest or the southwest. Any debris from Chrismas Island tests which may, by some unknown trajectory, have been carried to about latitude 25°N off the Mexican west coast might reasonably be carried to the region covered by the stations listed in table 1."

More detailed study of the succession of meteorological and other events in the midwest for mid-May was made possible by examining the profile of the St. Louis daily composite milk samples (figure 3). This profile shows iodine-131 not detectable on May 11, barely detectable on May 12, and reaching a peak on May 16. From the precipitation maps it is evident that some rain fell in the milkshed during May 9 and 10 with the possibility of deposition of fresh fission products at that time. However, the date when most of the young activity was introduced was probably May 11 when heavy rains with considerable deposition of young activity were reported in the area. (Note: these dates correspond to the map dates.) In this example iodine–131 was detected in market milk 1 or 2 days after the most probable date of its injection by rain. At least 5 days then elapsed before the radioiodine reached a peak in pasteurized milk.

Examining the iodine values in St. Louis milk further, the question is raised as to the meaning of the second and third peaks on May 18 and 22, since they may represent artifacts of experimental deviations, or further injections of fresh activity into the milk collection area. Although not shown in figure 1, weather maps and RSN data indicate trace to light rains with possible fresh fission products in the St. Louis milkshed on May 16 and 18. Conceivably they could have introduced sufficient activity to produce the later peaks, but the evidence is not conclusive since the first injection of activity was associated with a very heavy rainfall.

The Wichita radioiodine in milk profile in figure 1 shows a peak on May 13 one order of magnitude higher than the St. Louis peak. Since the May 15 milk sample showed nearly the same level of radioiodine as on the 13th, it is possible that the peak occurred between these dates. Applying a 5-day minimum lapse period derived from the St. Louis data places the estimated date of injection of radioiodine in the Wichita milk collection area as May 8 or 9. Although little or no rain was evident in the milkshed during that period, the young activity appearing in air on May 9 gives evidence of a substantial injection at that time. The mode of injection is open to question. If there were thunderstorms on May 8 or 9 similar to the ones described by Dr. Machta on May 10-14, such an injection from the stratosphere would be possible.

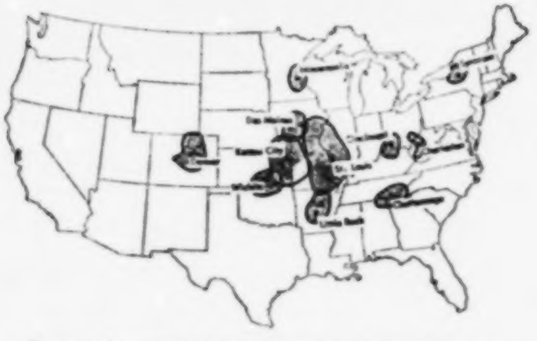


FIGURE 2.—SELECTED MILKSHED AREAS

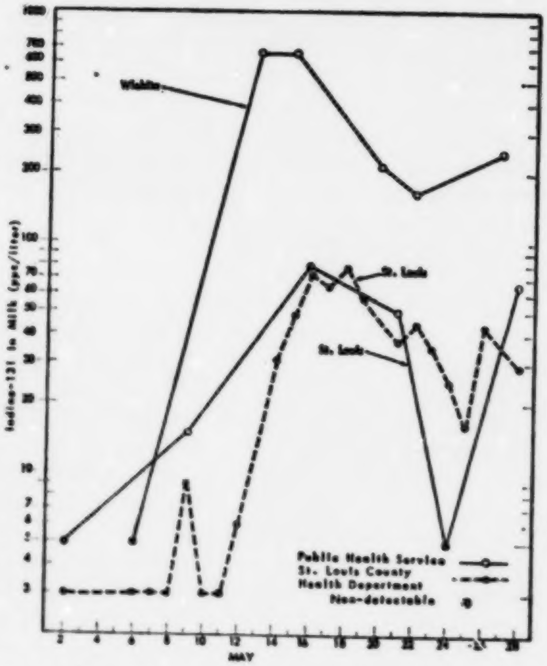


FIGURE 3.—SELECTED TIME PROFILES OF IODINE–131 IN MILK

Although heavy rains were probably involved in the St. Louis example (see figure 3) in the Wichita milkshed, trace or light scattered rains, or even some other mechanism for radioiodine deposition on pasture, could be implicated. This implication of the effects of spotty or trace rainfall supports the hypothesis that the second and third peaks in the St. Louis daily profile (figure 3) are real.

After the peak in a profile, and with no further injections, the iodine–131 concentrations in milk drop sharply. From the profile slope an effective half-life may be determined. Such a value may be useful in extrapolating iodine–131 in milk profiles back to a probable date of peak when no sample was collected on that day.

The profiles for several cities in table 2 (Kansas City, Des Moines, Omaha, and Wichita) having relatively high iodine–131 values show effective half-lives of 3 to 3.6 days. The St. Louis profile from PHS data shows a half-life of 7.2 days. However, if daily values are considered, using the St. Louis Health Department data, and the second and third peaks are presumed real, the downslopes average approximately 3.1 days effective half-life. The agreement of this value with those profiles of higher concentration lends further weight to the argument that the small peaks on the St. Louis profile are real. It also suggests that small injections of this type tend to flatten the slopes of lower activity range profiles such as St. Louis but have little effect on the slopes of higher activity range profiles such as Wichita.

Summary

From the data presented, it is apparent that, although gross beta concentrations in air do not always give indications of fresh fission product intrusions, the development of isocontour maps showing the age of fission products can demonstrate a meteorological event associated with an increase in radioiodine in milk. The St. Louis time-concentration profile of iodine–131 in market milk samples shows that radioiodine was detected 1 or 2 days after injection and reached a peak value about 5 days after injection of fresh fission products into the milk collection area. After the peak, an effective half life of 3.0 to 3.5 days was observed, excluding the effect of subsequent fresh fallout injections.

Also it appears that deposition of fresh activity onto the grass may be affected by heavy rains, by relatively light rains, or by some other mechanism. A final comment by Dr. Machta may suggest some explanations.

> ". . . If the rainfall at the station is taken literally as the amount which fell on the milkshed (and this has already been questioned), the highest reading at Wichita, for example, corresponded with only a trace of rain on 10–11 May. Is this amount of water, less than 0.01 inches, enough to bring down significant amounts of I^{131}? Is it likely that much of the I^{131} deposited on plants early in a rainshower is washed off by the later rain? Does a trace of rain which may have resulted from the evaporation of a much larger amount of water during descent contain just as much fission products, but these do not leave the water during its evaporation?"

External Gamma Activity

Division of Radiological Health, Public Health Service

Daily measurements of external gamma radiation are made at stations of the Radiation Surveillance Network to assure detection of any substantial deviations from normal background levels. Portable Geiger-Mueller survey instruments are used to obtain measurements at three feet above the ground surface. June 1962 data reported in table 1 are characteristic of individual station observations which in recent years have defined the range of normal background values.

TABLE 1.—EXTERNAL GAMMA ACTIVITY, JUNE 1962

Station location		Average (mr/hr)	Station location		Average (mr/hr)
City	State		City	State	
Adak	Alaska	0.01	Lansing	Mich	0.02
Anchorage	Alaska	0.01	Minneapolis	Minn	0.01
Attu	Alaska	0.01	Jackson	Miss	0.01
Fairbanks	Alaska	0.01	Pascagoula	Miss	*—
Juneau	Alaska	0.01	Jefferson City	Mo	0.01
Kodiak	Alaska	0.01	Helena	Mont	0.03
Nome	Alaska	0.01	Lincoln	Nebr	0.01
Point Barrow	Alaska	0.01	Las Vegas	Nev	0.01
St. Paul Island	Alaska	0.01	Trenton	N. J	0.02
Phoenix	Ariz	0.01	Concord	N. H	—
Little Rock	Ark	0.01	Santa Fe	N. Mex	0.04
Berkeley	Calif	0.01	Albany	N. Y	0.02
Los Angeles	Calif	0.02	Buffalo	N. Y	0.01
Denver	Colo	0.02	New York	N. Y	—
Hartford	Conn	0.01	Gastonia	N. C	0.02
Dover	Del	0.01	Bismarck	N. D	0.01
Washington	D. C	0.02	Columbus	Ohio	0.01
Jacksonville	Fla	0.02	Painesville	Ohio	0.01
Miami	Fla	0.01	Oklahoma City	Okla	0.02
Atlanta	Ga	0.03	Ponca City	Okla	0.02
Agana	Guam	0.01	Portland	Ore	0.02
Honolulu	Hawaii	0.01	Harrisburg	Pa	0.01
Boise	Idaho	0.02	San Juan	P. R	—
Springfield	Ill	0.01	Providence	R. I	0.02
Indianapolis	Ind	0.02	Columbia	S. C	0.02
Iowa City	Iowa	0.01	Pierre	S. D	0.02
Topeka	Kans	0.02	Nashville	Tenn	0.01
Frankfort	Ky	0.01	Austin	Tex	0.01
New Orleans	La	0.02	El Paso	Tex	0.02
Augusta	Maine	0.02	Salt Lake City	Utah	0.02
Presque Isle	Maine	0.02	Richmond	Va	0.01
Baltimore	Md	0.02	Seattle	Wash	0.02
Rockville	Md	0.01	Charleston	W. Va	0.02
Lawrence	Mass	0.02	Madison	Wis	0.01
Winchester	Mass	0.02	Cheyenne	Wyo	0.02

* Dash indicates no data received.

Strontium–90 In Human Bone

TRI-CITY BONE SAMPLING[1]
1960–1961

J. Rivera
Health and Safety Laboratory
Atomic Energy Commission

Since March of 1961, the Health and Safety Laboratory (HASL) has been collecting samples of human vertebrae from autopsies performed by pathologists in New York City, Chicago, San Francisco, and San Juan, Puerto Rico. These samples were from individuals whose nutrition and metabolism could reasonably be expected to have been normal just prior to death.

Vertebrae were selected as the bones to be analyzed, because they were expected to have higher strontium–90 concentrations than other bones. Samples were obtained from New York City, Chicago, and San Francisco, because estimates of the dietary intake of strontium–90 in these cities has been made every 3 months since March 1960 as a part of the Tri-City Diet Study (*1*). Samples were obtained from San Juan to see what effect a diet with less milk, and presumably less calcium, would have on the strontium–90 content of bone.

Data summarizing the dietary intake of strontium–90 in the 3 cities during 1960 and 1961 are presented in table 1. The estimates tabulated are based on more than 400 analyses of food made by HASL during the last 2 years.

---

[1] Quarterly Summary Report, *HASL–127*, p. 214 (July 1, 1962).

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TABLE 1.—ANNUAL PER CAPITA DIETARY INTAKE OF STRONTIUM-90

Year	New York City		Chicago		San Francisco	
	μμc/yr	μμc/gm Ca	μμc/yr	μμc/gm Ca	μμc/yr	μμc/gm Ca
1960	4300	11.2	3550	9.2	1700	4.4
1961	3700	9.7	2670	7.0	1290	3.6

The estimated per capita annual intake of strontium-90 and calcium by the lowest income group from San Juan, Puerto Rico, based on a single sampling of foods made in June 1961, was 1340 μμc Sr^{90} per year and 170 gm calcium per year (7.9 μμc Sr^{90}/g Ca) (*2*). Although the diet of individuals in this income group was not considered typical of Puerto Rico, it was likely to have been representative of the diet of the individuals from whom bone samples were obtained.

Estimates of the Sr^{90}/Ca ratio of the diet of infants during the first year of life in New York City, Chicago, and San Francisco, based on analyses of samples of foods especially prepared for consumption by infants, indicated that there was no appreciable difference between the ratio found in infant and adult diets at each of the cities (*3*).

From March 1961 to March 1962, over 450 bone samples were collected, of which 262 were considered suitable to be analyzed singly or as part of composite samples. A summary of the average Sr^{90}/Ca ratios found in the samples is presented in table 2 and plotted in figure 1.

Discussion

The general variation of Sr^{90}/Ca ratios in bone with age can best be seen in figure 1. The distribution with age of the points plotted is in agreement with that found by Kulp and Schulert (*4*), Bryant and Loutit (*5*), and other investigators. A peak from the youngest age bracket to about 5 years old can be noted, as well as a somewhat lower peak during the late teenage years. A gradual tapering off of the ratios in adult bones can also be noted. It may be mentioned that the values plotted are not characteristic of the skeleton as a whole, since no correction has been made for the faster turnover of vertebrae as compared to other bones in the adult.

New York City bones had the highest strontium-90 ratios, Chicago had intermediate ratios, and San Francisco had the lowest ratios, although there were many exceptions where pairs of samples of the same age were compared between cities. These results indicated that there was a direct proportionality between dietary Sr^{90}/Ca ratios and bone Sr^{90}/Ca ratios.

TABLE 2.—WEIGHTED AVERAGE STRONTIUM-90 CONTENT OF HUMAN VERTEBRAE

Age at death	New York City			Chicago			San Francisco			San Juan		
	No. of analyses	No. of samples in composite	Sr^{90} (μμc/gm Ca)	No. of analyses	No. of samples in composite	Sr^{90} (μμc/gm Ca)	No. of analyses	No. of samples in composite	Sr^{90} (μμc/gm Ca)	No. of analyses	No. of samples in composite	Sr^{90} (μμc/gm Ca)
0-1	4	8	3.43	1	1	1.40	2	10	0.49			
1-2	3	5	2.67				3	3	0.79			
2-3	2	2	2.34									
3-4	3	5	2.05	1	1	2.26	3	4	1.33			
4-5	4	4	1.74	2	3	2.08	2	2	2.15			
5-6	1	1	1.51							1	1	0.93
6-7	5	5	1.37									
7-8	3	3	1.62				2	2	0.82	1	1	1.38
8-9							1	1	0.78	1	1	0.80
9-10	2	2	1.20				2	4	1.18			
10-12	2	2	1.55	2	2	1.37	2	2	0.62	2	3	0.85
12-14	2	2	0.62	1	2	1.03	1	1	0.67	1	1	0.89
14-16	3	3	1.16	2	2	1.37	1	1	1.68	1	1	1.69
16-18	6	6	1.44	1	1	1.36				2	3	1.41
18-20	11	11	1.03	3	3	0.48				5	7	1.14
20-40	4	16	1.05	1	10	0.57	3	15	0.50	2	10	0.93
40-60	2	10	0.83	2	20	0.44	2	15	0.46	2	10	0.70
>60	1	5	0.69	1	9	0.76	2	15	0.50	1	5	0.96
Total	58	90		17	54		26	75		19	43	

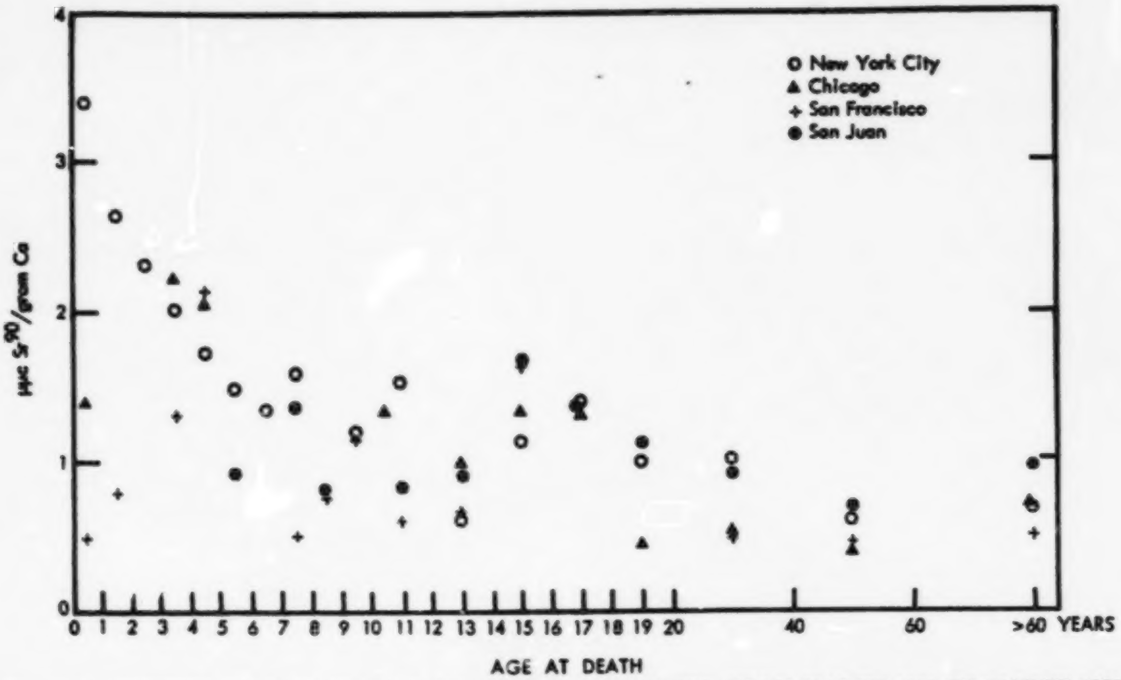

FIGURE 1.—STRONTIUM-90 IN HUMAN VERTEBRAE COLLECTED FROM MARCH 1961 TO MARCH 1962

The San Juan, P. R., bone Sr^{90}/Ca ratios were comparable to those observed in New York City. Since the intake of Sr^{90} at San Juan was much less than in New York City, the proportionality between bone Sr^{90}/Ca ratios and diet Sr^{90}/Ca ratios is seen to be a true one, and not just a proportionality with total Sr^{90} intake, as might be inferred from the data obtained from the 3 mainland cities alone.

Although dietary intake estimates are available for New York City, Chicago, and San Francisco for 1960, insufficient data exist on bone Sr^{90}/Ca ratios from these cities for 1960 to accurately test the predictive models that have been suggested for strontium-90 levels in man by comparing bone levels from the same area in successive years. However, it should be possible to evaluate the accuracy of these models by this method when data are collected on bone samples obtained from March 1962 to March 1963.

It is hoped that when the current analyses for stable strontium in bone and diet samples are completed, calculations of the specific activity of strontium in bones and that in diet can be used as was done by Bryant and Loutit (*5*) to add to the knowledge of bone metabolism.

Previous coverage in *Radiological Health Data:*

Period	*Issue*
1959 and 1960	*May 1960*
1959 and 1960	*July 1960*
1958, 1959 and 1960	*January 1961*
1957, 1958, 1959, 1960	*February 1961*
1957, 1958, 1959, 1960	*April 1961*
1959 and 1960	*May 1961*
1958 and 1959	*June 1961*

REFERENCES

(*1*) USAEC Report No. *HASL–90*: 19–20 (August 18, 1960).

(*2*) USAEC Report No. *HASL–122*: 183 April 1, 1962).

(*3*) USAEC Report No. *HASL–122*: 185 (April 1, 1962).

(*4*) Kulp, J. L. and Schulert, A., "Strontium-90 in Man V," *Science 136*: 619–632 (May 18, 1962).

(*5*) Bryant, F. J. and Loutit, J. F., "Human Bone Metabolism Deduced From Strontium Assays," *U. K. Report No. AERE–R 3718*, HMSO, London (1961).

CANADIAN HUMAN BONE SAMPLING PROGRAM[1]
1960

Radiation Protection Division
Department of National Health and Welfare
Ottawa, Canada

For this program samples of human bone are obtained through the cooperation of hospital pathologists and are analyzed for strontium–90. During 1960 the program was expanded considerably and samples are now received from nearly all of the major cities in Canada. Starting at the beginning of the year sample collection was modified in two ways: (1) by limiting the bone type to vertebrae, in order to provide a more consistent set of data; and (2) by selecting samples as much as possible in line with population distribution. However, the number collected from each region is not sufficient to permit a statistical study of possible regional or age differences.

Results

The results of the analyses are shown in table 3, arranged in groups according to the ages of the subjects from which the samples were taken. In some cases samples from several subjects were pooled in order to obtain enough material for the analyses. Average values of the concentration are taken over the total number of subjects, the results for pooled samples being regarded as sub-averages.

As discussed in the Annual Report for 1959 (*1*), the concentration of strontium–90 in vertebrae does not accurately represent the average concentration in the whole skeleton, which is expected to be lower by a factor of 1.8. In children, however, the concentration in the different parts of the skeleton is expected to be more uniform.

The average values for the different age groups are shown in the histogram in figure 2. In adults, the lower values assumed for the whole skeleton (factor, 1.8) are represented by a dotted line. Since this factor does not apply to children, the line is not extended into the younger age groups.

It is of interest to compare these data with the corresponding values in 1959. In general, it would appear that the average concentration of strontium–90 in human bone has increased by a factor of about 1.5 in children and by a factor of about 2 in adults. This increase is roughly in agreement with the prediction in the 1959 report, which was based on a mathematical analysis of the data at that time. This predicted value is shown in figure 1. It was based on the assumption of a continued, almost linear increase in the concentration in the diet. Actually, as has been demonstrated by milk in this report, the concentration in food decreased somewhat during the year. If allowance was made for this, the calculated level would be reduced slightly, tending to bring it into better agreement with the observed values.

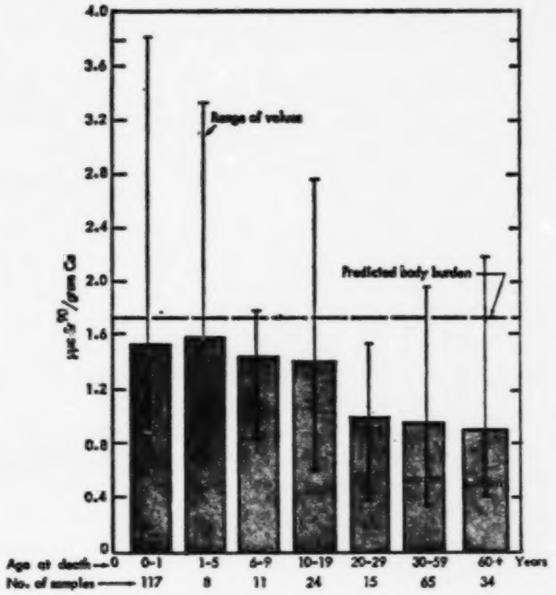

FIGURE 2.—HUMAN BONE DATA, 1960

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[1] Bird, P. M., A. H. Booth, and P. G. Mar, *Annual Report for 1960 of the Radioactive Fallout Study Program, CNHW (RP-4)* December 1961.

TABLE 3.—STRONTIUM-90 IN HUMAN BONE SAMPLES

Age group	Location of hospital contributing sample	No. of subjects (pooled)	Strontium-90 (μμc/gm Ca)
0-1 year			
0-12 mo.	Toronto	5	2.32
0-19 hr.	Montrea	12	0.89
0-1 day		6	0.77
0-1 day		13	0.96
1-3 day		12	0.88
5-10 day		6	1.42
0-1 mo.		7	0.82
0-40 day		17	1.16
14-35 day		10	1.22
1-5 mo.		5	2.08
2-6 mo.		7	1.88
2-8 mo.		3	3.71
6-12 mo.		14	3.36
		117	1.52 (Avg)
1-5 years	Edmonton	1	1.31
	Regina	1	1.28
	Toronto	1	1.49
	Montreal	3	0.65
		2	3.31
		8	1.58 (Avg)
6-9 years	Regina	1	1.65
		1	0.93
		1	1.53
	Sault Ste. Marie	1	1.28
	Toronto	1	1.11
	Montreal	1	1.05
		1	1.77
		1	0.83
	Quebec	1	3.07
		1	1.67
	Halifax	1	0.85
		11	1.43 (Avg)
10-19 years	Victoria	1	1.52
		1	1.53
	Vancouver	1	1.71
		1	1.90
		1	0.97
		1	2.04
		1	0.89
	New Westminster	1	1.33
	Saskatoon	1	1.36
		1	0.62
	Winnipeg	1	1.96
	Sault Ste. Marie	1	1.06
		1	0.78
		1	1.27
	Montreal	1	1.36
		1	1.64
		1	1.93
		1	0.91
		1	1.41
		1	0.59
	Quebec	1	1.60
		1	1.35
		1	1.75
	Halifax	1	2.75
		24	1.41 (Avg)
20-29 years	Victoria	1	1.18
	Vancouver	1	0.69
		1	0.39
	New Westminster	1	0.99
	Edmonton	1	0.41
		1	0.76
	Regina	1	1.30
		1	0.62
	Saskatoon	1	1.26
	Kingston	1	1.05
	Ottawa	1	0.97
		1	0.98
	Montreal	1	1.24
	Quebec	1	0.92
	Halifax	1	1.52
		15	0.96 (Avg)
30-59 years	Victoria	1	0.58
		1	0.44
		1	0.76
		1	0.70
	Vancouver	1	1.55
		1	0.37
		1	0.78
		1	1.50
		1	0.77
		2	0.71
		2	0.73
	New Westminster	1	1.14
		1	0.56
	Edmonton	1	0.99
		1	1.97
		1	0.88
		1	0.33
		1	0.62
		1	0.79
		1	0.74
	Calgary	1	0.68
	Regina	1	0.92
		1	0.61
		1	1.21
	Winnipeg	1	1.18
		1	1.27
		1	1.48
	St Boniface	1	0.77
		1	1.19
	Sault Ste. Marie	1	0.93
		1	0.64
		1	0.79
	Toronto	1	0.49
	Kingston	1	0.53
		1	0.51
	Ottawa	1	0.69
		1	0.84
		1	1.37
		1	0.74
		1	0.57
		1	0.72
		1	0.91
		1	1.07
		1	0.85
		1	1.00
		1	0.55
		1	1.17
		1	0.78
	Montreal	1	0.93
		1	0.79
		1	1.52
		1	0.84
		1	1.23
		1	1.48
		1	1.37
		1	1.92
	Quebec	1	0.84
		1	0.80
	Halifax	1	1.69
		1	1.44
		1	1.37
		65	0.92 (Avg)
60 years and over	Victoria	1	1.03
		1	0.72
		1	0.61
		1	0.77
		1	0.66
	Vancouver	1	0.70
		1	0.65
		3	0.83
	New Westminster	1	1.40
	Edmonton	1	0.77
	Calgary	1	0.94
	Regina	1	0.41
		1	0.73
	Winnipeg	1	1.41
		1	1.38
	Kingston	1	0.57
		1	0.53
	Ottawa	1	0.94
		1	1.05
		1	0.93
		1	0.84
		1	0.65
		1	0.97
		1	0.91
		1	1.23
		1	0.78
	Montreal	1	0.61
		1	0.89
		1	2.16
		1	0.65
		1	0.40
	Halifax	1	0.87
		34	0.87 (Avg)

REFERENCE

(1) Bird, P. M., A. H. Booth, and P. G. Mar, *Annual Report for 1959 of the Radioactive Fallout Study Program, CNHW (RP-3)* May 1960.

Previous bone data in *Radiological Health Data*:

Period	*Issue*
1958, 1959, and 1960 (human, USA)	*May 1960*
1959 and 1960 (human, USA)	*July 1960*
1958, 1959, and 1960 (human, USA)	*January 1961*
1957 and 1958 (human, animal, Canada, USA)	*February 1961*
1960 (human, USA)	*March 1961*
1957 through 1960 (human, USA)	*April 1961*
1959 and 1960 (human, USA)	*May 1961*
1958 and 1959 (human, Japan)	*June 1961*
1960 (bovine, USA)	*August 1961*
1956 through 1961 (animal, worldwide)	*March 1962*

Environmental Levels of Radioactivity at Atomic Energy Commission Installations

The U.S. Atomic Energy Commission receives from its contractors quarterly reports on the environmental levels of radioactivity in the vicinity of major Commission installations. The reports include data from routine monitoring programs where operations are of such a nature that plant perimeter surveys are required.

Various summaries of the environmental radioactivity data for 21 AEC installations have appeared in *Radiological Health Data* since November 1960. Summaries follow for Oak Ridge Area, Portsmouth Area Gaseous Diffusion Plant, and Savannah River Plant for third and fourth quarters 1961.

The measured concentration of a radionuclide in air and water may be compared with the Maximum Permissible Concentration (MPC) of that nuclide as recommended by the National Committee on Radiation Protection and Measurement (NCRP). For the environment near an AEC installation, the applicable MPC's are one-tenth of the occupational MPC values for continuous exposure given in National Bureau of Standards, *Handbook 69*.[1] The MPC values applicable to the following reports are given in table 1.

To avoid any possible misunderstandings in the use of the term "Maximum Permissible Concentrations," the Federal Radiation Council (FRC) has recommended the term "Radioactivity Concentration Guide" (RCG) for the use of Federal Agencies. Although FRC has not published a table of RCG values, several AEC installations, such as Savannah River Plant, have adopted FRC nomenclature and use the NCRP published values or derive their own RCG values. For a more detailed description of the meaning and use of the RCG, the reader is referred to FRC Report No. 2.[2] Radiation Protection Guides (RPG's) in terms of total intake in $\mu\mu c$/day averaged over a 1-year period are reported in FRC Report No. 2 for radium, iodine-131, and strontium-90. (See footnote b in table 1, below.)

In the following reports, the use of nonspecific terms such as "total activity," "total alpha," and "gross beta" do not in themselves suggest any one MPC value. Often, when concentrations are low a laboratory will assign an MPC value that is more restrictive than necessary. This avoids the more costly isotopic tests necessary to justify a less restrictive value. References to table 1 will be made to designate the appropriate MPC's reported by the laboratories.

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[1] National Bureau of Standards, *Maximum Permissible Body Burdens and Maximum Permissible Concentrations of Radionuclides in Air and in Water for Occupational Exposure, Handbook 69*, Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C. (June 5, 1959) Price 35 cents.

[2] Federal Radiation Council, *Background Material for the Development of Radiation Protection Standards, Report No. 2*, Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C. (September 1961) Price 20 cents.

TABLE 1.—SELECTED ENVIRONMENTAL MPC VALUES PERTAINING TO AEC INSTALLATION REPORTS BELOW

Line	Radionuclide or mixture of unknown nuclides	Environmental MPC's	
		Water ($\mu\mu c$/liter)	Air ($\mu\mu c/m^3$)
1	If Sr^{90}, I^{129}, Pb^{210}, Po^{210}, At^{211}, Ra^{223}, Ra^{224}, Ra^{226}, Ac^{227}, Ra^{228}, Th^{230}, Pa^{231}, Th^{232}, and Th-nat are not present [a]	3,000	—
2	If Sr^{90}, Pb^{210}, Ra^{226}, Ra^{228} are not present [a]	600	—
3	If Ra^{226}, Ra^{228} are not present [a]	100	—
4	Mixture of unidentified nuclides	10	0.04
5	If α emitters and Ac^{227} are not present [a]	—	1.0
6	If α emitters and Pb^{210}, Ac^{227}, Ra^{228}, Pu^{241} are not present [a]	—	10
7	If α emitters and Sr^{90}, I^{129}, Pb^{210}, Ac^{227}, Ra^{228}, Pa^{230}, Pu^{241}, Bk^{249} are not present [a]	—	100
8	Cerium-144	10,000	200
9	Cesium-137	20,000	500
10	Cobalt-60	30,000	300
11	Hydrogen-3 (tirtium)	3,000,000 [b](300,000)	200,000
12	Iodine-131	2,000 [b](700)	300 [b](100)
13	Ruthenium-103-106	10,000	200
14	Strontium-90	100 [b](33)	10
15	Thorium-234	20,000	100
16	Uranium-natural	20,000	2

[a] "Not present" implies the concentration of the nuclide is small compared with its appropriate MPC. According to AEC regulations, a group of nuclides may be considered not present if the ratio of each nuclide is equal to or less than 1/10 of its appropriate MPC and if the sum of these ratios for the group in question is equal to or less than 1/4.

[b] Numbers in parentheses are the RCG values used by the Savannah River Plant The RPG's for daily intake of iodine-131 and strontium-90 as recommended by FRC (top of range II) are 100 and 200 $\mu\mu c$/day, respectively.

OAK RIDGE AREA

Third and Fourth Quarters 1961

Union Carbide Nuclear Company
Oak Ridge, Tennessee

This report presents third and fourth quarter 1961 data on the environmental levels of radioactivity for the Oak Ridge Area. As shown in figure 1, K–25 Area, X–10 and Y–12 areas are located within the large AEC-controlled Oak Ridge Area. The Oak Ridge National Laboratory (ORNL) is located within the X–10 area and the Oak Ridge Gaseous Diffusion Plant (ORGDP) is located within the K–25 area.

Radioactive waste materials arising from the operation of atomic energy installations at Oak Ridge are collected, treated, and disposed of according to their physical states. Solid wastes are buried in a Conasauga shale formation which has a marked ability to fix radioactive materials by ion exchange. Liquid wastes, which contain long-lived fission products, are confined in storage tanks or are released to trenches and pits located in the Conasauga shale formation. Low level liquid wastes are discharged, after preliminary treatment, to the surface streams. Air that may become contaminated by radioactive materials is exhausted to the atmosphere from several tall stacks after treatment by means of filters, scrubbers, and/or precipitators.

Air Monitoring

Atmospheric contamination by long-lived fission products and fallout occurring in the general environment of East Tennessee are monitored by 2 systems of monitoring stations. One system consists of 7 stations which encircle the plant areas (figure 1) and provides data for evaluating the impact of all Oak Ridge Operations on the immediate environment. A second system consists of 8 stations encircling the Oak Ridge Area at distances of from 12 to 120 miles (figure 2). This system provides data to aid in evaluating local conditions and to assist in determining the spread or dispersal of contamination should a major incident occur. Sampling is carried out by passing air continuously through a filter paper. Average concentrations are tabulated in table 2.

Atmospheric contamination by uranium was determined during the third quarter by taking

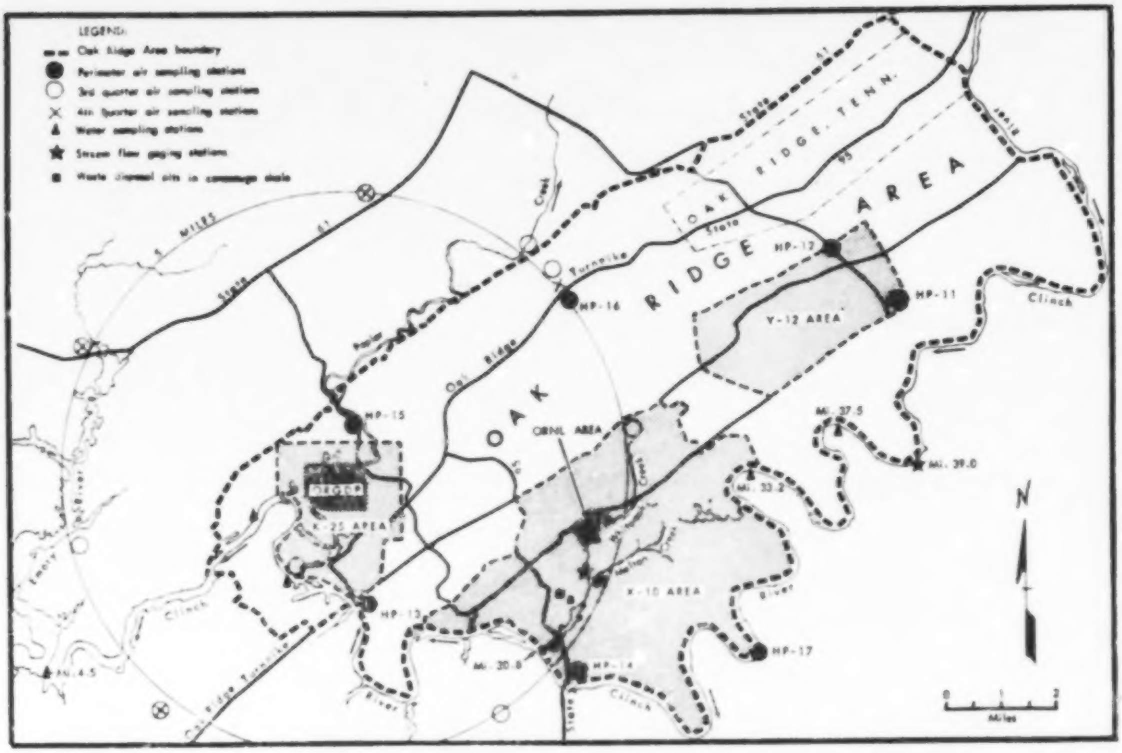

FIGURE 1.—OAK RIDGE AREA ENVIRONMENTAL SAMPLING LOCATIONS

periodic air samples at eight locations on a five-mile radius from the ORGDP (figure 1). In the fourth quarter, the procedure was changed to provide continuous sampling at the five sites indicated in figure 1.

The average beta activity in air during this six-month period was considerably higher than the levels of the first and second quarters of 1961. However, this increase is attributed to weapons test fallout which began arriving in the Oak Ridge area on September 17, 1961. The air contamination collected on the filters was identified by gamma spectrometry as mixed fission products such as might be expected from weapons tests. These activity levels are no greater than the average of those measured in other areas of the United States.

The average air-borne alpha activity as measured five miles from the ORGDP did not increase appreciably over previous quarters; and the third and fourth quarter levels were 2.3 and 12 percent respectively of the maximum permissible concentration for populations in the neighborhood of a controlled area.

TABLE 2.—LONG-LIVED GROSS BETA CONCENTRATIONS IN AIR, OAK RIDGE AREA

[Average concentrations in μμc/m³]

Station number (see figures 1 and 2)	Third quarter 1961		Fourth quarter 1961	
	Number of samples	Average gross β	Number of samples	Average gross β
Perimeter stations:				
HP-11	14	2.05	13	3.2
HP-12	14	2.18	13	3.7
HP-13	14	1.98	13	3.5
HP-14	14	1.65	13	3.2
HP-15	14	2.09	13	4.0
HP-16	14	1.90	13	3.4
HP-17	14	2.28	13	3.6
All perimeter stations	98	2.00	91	3.5
Remote stations:				
HP-19	14	2.28	13	4.1
HP-20	14	2.66	13	3.8
HP-21	14	2.31	13	4.3
HP-22	14	2.04	13	4.1
HP-23	14	3.10	13	4.4
HP-24	14	3.00	13	4.6
HP-25	14	1.72	13	3.7
HP-26	14	1.79	13	3.4
All remote stations	112	2.36	104	4.1

Water Monitoring

Large volume, low level liquid wastes originating at ORNL are discharged, after some preliminary treatment, into the Tennessee

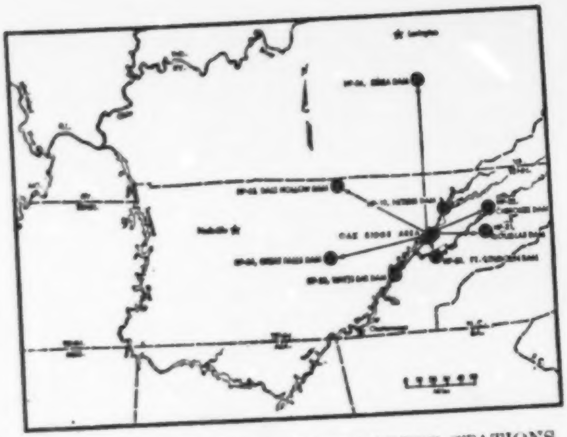

FIGURE 2.—REMOTE AIR MONITORING STATIONS OAK RIDGE AREA

River System by way of White Oak Creek and the Clinch River. Liquid wastes originating at the ORGDP and the Y-12 Plant are discharged to Poplar Creek and thence to the Clinch River. Releases are controlled so that resulting average concentrations in the Clinch River comply with the maximum permissible levels for populations in the neighborhood of a controlled area as recommended by the National Committee on Radiation Protection (NCRP). The concentration of radioactivity leaving White Oak Creek is measured, and concentration values for the Clinch River are calculated on the basis of the dilution provided by the river.

TABLE 3.—CONCENTRATIONS OF ALPHA-EMITTING MATERIALS IN AIR FIVE MILES FROM ORGDP

[Average concentrations in $\mu\mu c/m^3$]

Period (1961)	Type of analysis	Type of sampling	Number of samples	Concentration
Third quarter (8 stations)	Uranium concentration	Random; 10 minute samples	10	0.045
Fourth quarter (5 stations)	Gross alpha[a]	Continuous	592	0.24

[a] Interpreted as uranium.

Water samples are taken at a number of locations in the Clinch River, beginning at a point above the entry of wastes into the river and ending at Center's Ferry near Kingston, Tennessee. Stream gauging operations are carried on continuously by the U.S. Geological Survey to obtain dilution factors for calculating the probable concentrations of wastes in the river.

Samples are analyzed for the long-lived beta emitters, for uranium, and for the transuranic alpha emitters.

Analyses are made of the effluent for the

TABLE 4.—CONCENTRATIONS OF MAJOR RADIONUCLIDES IN THE CLINCH RIVER

[Average concentrations in $\mu\mu c$/liter]

Radionuclide	Third quarter 1961			Fourth quarter 1961		
	Location on Clinch River[a]			Location on Clinch River[a]		
	Mi. 33.2 (Upstream)	Mi. 20.8[b] (Outfall)	Mi. 4.5 (Downstream)	Mi. 33.2 (Upstream)	Mi. 20.8[b] (Outfall)	Mi. 4.5 (Downstream)
Sr^{90}	1.0	2.3	2.5	0.8	2.8	3.3
Ce^{144}	0.5	0.2	1.1	0.4	1.0	1.8
Cs^{137}	[c]ND	1.7	0.5	0.5	2.5	0.9
$Ru^{103,106}$	4.5	90	59	9.0	270	210
Co^{60}	ND	1.3	0.2	0.6	3.0	3.6
Gross beta	3.0	170	92	2.8	530	240

[a] The location on Clinch River is given in terms of the distance upstream from the Tennessee River. See figure 1.

[b] The concentrations at mi. 20.8 are not measured directly but the values calculated on the basis of levels of waste released and the dilution afforded by the river. These concentrations therefore do not include activity from fallout and therefore are not directly comparable to measured activity at the other points.

[c] ND—indicates none detected.

TABLE 5.—URANIUM CONCENTRATION IN THE CLINCH RIVER, OAK RIDGE AREA

[Average concentrations in $\mu\mu c$/liter]

Sampling location	Third quarter 1961		Fourth quarter 1961	
	Number of samples	Uranium concentration	Number of samples	Uranium concentration
Upstream from ORGDP	14	1.8	13	1.1
Downstream from ORGDP	13	2.7	12	2.3

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TABLE 6.—EXTERNAL GAMMA RADIATION LEVELS, OAK RIDGE AREA

[Average dose rates in mr/hr]

Location	Third quarter 1961	Fourth quarter 1961
Solway Gate	0.015	0.021
Y-12 East Portal	0.018	0.019
Newcomb Road	0.017	0.020
Gallaher Gate	0.023	0.023
White Wing Gate	0.021	0.019
Average	0.019	0.020

long-lived radionuclides only, since cooling time and holdup time in the waste effluent system is such that short-lived radionuclides are not present. The averages are tabulated in tables 4 and 5.

Gamma Measurements

External gamma radiation levels are measured monthly at a number of locations in the Oak Ridge Area. Measurements are taken with a Geiger-Mueller tube at a distance of 3 feet above ground, and the results are tabulated in table 6 in terms of mr/hr. Although a slight increase was noted over the first and second quarter levels, the time of this increase coincides with the arrival of weapons test fallout.

Conclusion

The air and ground contamination in the immediate and remote environs of Oak Ridge increased during the third and fourth quarters of 1961, but was identified as originating from sources other than local plant operations.

The release of low level radioactive liquid wastes contributes some radioactivity to the Clinch River, but the concentrations remain well below the maximum permissible concentration recommended by the NCRP.

Previous coverage in *Radiological Health Data*

Period	*Issue*
1959 and first quarter 1960	*December 1960*
Second and third quarters 1960	*March 1961*
Fourth quarter 1960	*July 1961*
First and second quarters 1961	*January 1962*

PORTSMOUTH AREA GASEOUS DIFFUSION PLANT

Third and Fourth Quarters 1961

Goodyear Atomic Corporation
Portsmouth, Ohio

The separation of uranium isotopes by the gaseous diffusion process presents control problems similar to any chemical process using toxic solvents and extraction solutions. Natural uranium and thorium–234 are the most likely radionuclides to be released to the environment by the Portsmouth Area Gaseous Diffusion Plant. Since natural uranium is an alpha emitter and thorium–234 is a beta-gamma emitter, environmental monitoring is conducted for evidence of alpha and beta-gamma emitters to test the effectiveness of plant controls.

Air samples are collected monthly at 17 sites located from 1 to 6 miles from the plant as shown in figure 3. Monthly water samples are collected at 14 locations within 5 miles of the plant.

Average alpha and beta-gamma concentrations in air and water are summarized in table 7. The external gamma levels are measured at the air sampling locations shown in figure 3 and the results included in table 7.

A marked increase of airborne beta-gamma

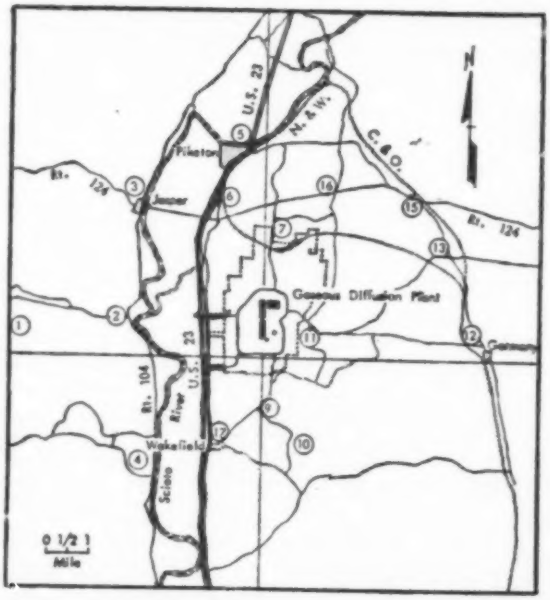

FIGURE 3.—AIR SAMPLING LOCATIONS, PORTSMOUTH GASEOUS DIFFUSION PLANT

TABLE 7.—AVERAGE LEVELS OF RADIOACTIVITY IN THE ENVIRONMENT OF THE PORTSMOUTH PLANT

Basis of measurement	Third quarter 1961		Fourth quarter 1961	
	Number of samples	Concentration	Number of samples	Concentration
Air-alpha concentration	47	0.1 $\mu\mu c/m^3$	45	0.1 $\mu\mu c/m^3$
Air-beta-gamma concentration	45	0.7 $\mu\mu c/m^3$	45	5.2 $\mu\mu c/m^3$
Water-alpha concentration	40	27 $\mu\mu c$/liter	38	30 $\mu\mu c$/liter
Water-beta-gamma concentration	40	62 $\mu\mu c$/liter	38	49 $\mu\mu c$/liter
External gamma	45	0.013 mrad/hour	45	0.019 mrad/hour

activity was noted during the fourth quarter 1961. However, this increase was expected because of the resumption of nuclear weapons testing in September 1961. The constant alpha activity levels imply that the beta-gamma increase was not a result of plant operations.

Water alpha and beta-gamma concentrations remain essentially unchanged from previous quarters. The slight increase in external gamma dose rate is evidently a consequence of nuclear weapons testing fallout. Total amount of radiation detected was too small to determine the amount, if any, attributable to plant operations.

Previous coverage in *Radiological Health Data*

Period	*Issue*
1959 and first quarter 1960	*November 1690*
Second and third quarters 1960	*March 1961*
Fourth quarter 1960	*August 1961*
First and second quarters 1961	*February 1962*

SAVANNAH RIVER PLANT

Third and Fourth Quarters 1961

E. I. du Pont de Nemours
Aiken, South Carolina

The Savannah River Plant (SRP) maintains a continuous monitoring program to determine the concentrations of radioactive materials in a 1200 square mile area outside the plant perimeter. Included in this area are parts of Aiken, Barnwell, and Allendale Counties in South Carolina and Richmond, Burke, and Screven Counties in Georgia. This program, initiated in 1951 prior to plant operations, is carried out by the Health Physics Section of E. I. du Pont de Nemours and Company, prime contractor for operation of the plant for the Atomic Energy Commission.

Although plant operations discharge some very low level gaseous and liquid wastes to the environment by controlled releases, dispersal is adequate to insure that the concentration of radioactive materials is well below the Radiation Concentration Guide (RCG) included in table 1. Continuous surveillance of the Savannah River Plant provides information useful both as a measure of the effectiveness of plant controls and as evidence of the strict adherence to the recommended RCG.

In most cases during the autumn of 1961, the low levels of radioactivity released to the environs by the SRP were obscured by fallout from the U.S.S.R. nuclear weapons testing.

Atmospheric Monitoring

Continuous air and rainwater samples are collected at 15 monitoring stations. These stations, which include 5 locations at the plant perimeter and 10 locations approximately 25 miles from the center of the plant, are spaced so that a measurable plant release of radioactivity to the air would be detected regardless of prevailing wind conditions (see figure 4). Four additional air monitoring stations are operated approximately 100 miles from the plant at Savannah and Macon, Georgia, and Columbia and Greenville, South Carolina (see figure 5). At this distance, the effect of SRP operations is minimal, and, therefore, these facilities serve as "reference points" for determining background levels of activity. The complete system of 19 stations permits a comprehensive surveillance of atmospheric radioactivity and differentiation between weapons testing fallout and plant releases. The average concentrations of radio-

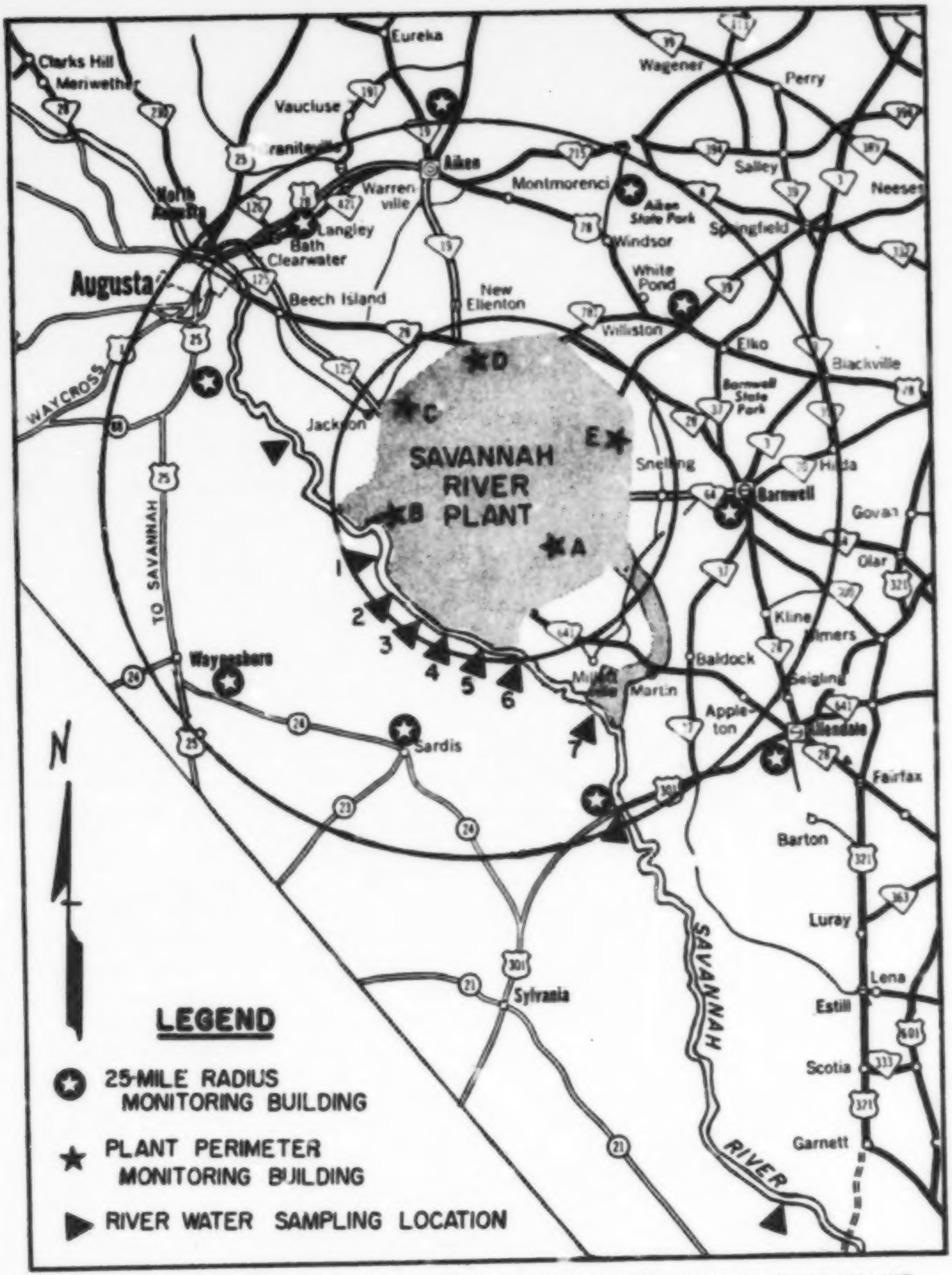

FIGURE 4.—ENVIRONMENTAL SAMPLING LOCATIONS, SAVANNAH RIVER PLANT

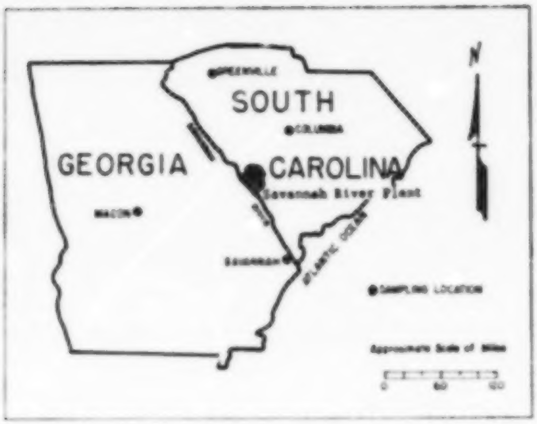

FIGURE 5.—DISTANT AIR MONITORING STATIONS, SAVANNAH RIVER PLANT

activity in air and rainwater are given in tables 8 and 9. The increase noted in radioactivity during this period is explained by the arrival of fallout from weapons testing which began in September 1961.

Milk

Milk samples were collected weekly from dairies and farms in Aiken, North Augusta, Snelling, Talatha, and Langley, South Carolina, to be analyzed for tritium and radioiodine content. Quarterly samples of milk were taken from the above locations; Williston, South Carolina; and Waynesboro and Sylvania, Georgia, for analysis of strontium-90 content. Average concentrations of tritium, iodine-131, and strontium-90 are given in table 10.

The concentration of strontium-90 in milk during this period was not significantly higher than in previous quarters and showed no effect of the 1961 nuclear tests. However, radioiodine contamination from fallout was evident, and the exposure to young children from consumption of iodine-131 contaminated milk in the vicinity of the plant for the calendar year 1961 is of particular interest. The cumulative thyroid dose due to consumption of contaminated dairy milk (resulting both from plant-released radioiodine in early June and from weapons test fallout) was below the 500 mrem annual limit recommended by the Federal Radiation Council, as shown below. The calculations were based on average concentrations in dairy milk, a child's thyroid weighing 2 grams, and the consumption of one liter of milk daily. An adult consuming one liter of milk daily woud have received only 10 percent of a child's thyroid exposure.

1961	Average population dose to a child (mrem)
June	63
September	102
October	93
November	27
December	6
Total	291

The June dose was caused by plant release. All the other doses were due to weapons test fallout. Concentrations of radioiodine in milk

TABLE 8.—RADIOACTIVITY IN AIR

[Average concentrations in µµc/m³]

Period	Source of samples	Alpha	Nonvolatile beta	Iodine-131
Third quarter 1961	Plant perimeter	0.0006	1.8	0.1
	25-mile radius	0.0005	2.1	0.1
	100-mile radius	0.0008	2.8	NS*
Fourth quarter 1961	Plant perimeter	0.0007	5.5	0.2
	25-mile radius	0.0008	5.0	0.2
	100-mile radius	0.0009	4.7	NS

* NS indicates no sample.

TABLE 9.—RADIOACTIVITY IN RAINWATER

[Average concentrations in µµc/liter]

Period	Source of samples	Alpha	Nonvolatile beta	Iodine-131
Third quarter 1961	Plant perimeter	0.4	99	18
	25-mile radius	0.3	72	14
Fourth quarter 1961	Plant perimeter	0.4	1740	61
	25-mile radius	0.5	1100	52

TABLE 10.—RADIOACTIVITY IN MILK

[Average concentrations in µµc/liter]

Type of test	Third quarter 1961	Fourth quarter 1961
Tritium (H^3)	7000	4600
Iodine-131	59	98
Strontium-90		
Single cow samples	27	27
Local dairies	11	12
Major distributors	13	12

during 7 months of 1961 (January through May and July through August) were below the limit of detection (6 µµc/liter).

Vegetation

Bermuda grass, because of its importance as a pasture grass for dairy herds and its year-round availability, was selected for analysis of radioactive contamination.

Average concentrations of alpha emitters, nonvolatile beta emitters, and radioiodine found on vegetation collected at the air monitoring locations shown in figure 4 are summarized in table 11.

The increase of radioiodine concentration over previous quarters was coincident with the arrival of weapons test fallout. As indicated by the relatively small difference of concentrations between plant perimeter and distant locations, the radioiodine fallout showed no correlation with plant releases.

Algae and Fish in Savannah River

Determination of radioactivity concentrations in algae is important because algae are concentrators of specific radionuclides and also have an important relationship in the food chain of aquatic organisms. Indigenous algae samples were collected weekly upstream from, adjacent to, and downstream from the plant. The average nonvolatile beta concentrations are given in table 12. Some correlation of plant effluent entry into the river is indicated by the lower upstream values.

TABLE 12.—NONVOLATILE BETA IN SAVANNAH RIVER ALGAE

[Average concentrations in µµc/gm]

Period	Location	Nonvolatile beta
Third quarter 1961	Adjacent to plant	67
	Upstream	26
	Downstream	34
Fourth quarter 1961	Adjacent to plant	242
	Upstream	51
	Downstream	81

Fish taken from the river showed no evidence of plant-contributed radioactivity.

Water Monitoring

Communities in the vicinity of SRP obtain sanitary water from deep wells or surface streams. Public water samples are collected monthly from 14 surrounding towns. Savannah River water is sampled continuously at 7 locations. Six of the locations are shown in figure 1; the seventh is 60 miles downstream from the plant.

Quarterly average concentrations of alpha and beta activity in public and Savannah River water are presented in table 13. The values shown indicate that plant operations contribute small amounts of radioactivity to the Savannah River, but the resulting concentrations are far below RCG values.

External Gamma Radiation Levels

Environmental gamma radiation dose rates are measured continuously at the 15 air monitoring stations shown in figure 4. The average dose rates at the plant perimeter were 0.34 mr/24 hours for both the third and fourth quarters. At the 25-mile radius locations, the rates were 0.34 and 0.38 mr/24 hours for the third and fourth quarters, respectively. For comparison, the North American average of environmental gamma radiation was 0.41 mr/24 hours during September 1961 (see *Radiological Health Data*, December 1961, p. 533).

TABLE 11.—RADIOACTIVITY IN VEGETATION (BERMUDA GRASS)

[Average concentrations in µµc/gm]

Period	Source of samples	Alpha	Nonvolatile beta	Iodine-131
Third quarter 1961	Plant perimeter	<0.12	18	3.0
	25-mile radius	<0.12	28	5.0
Fourth quarter 1961	Plant perimeter	0.15	127	3.7
	25-mile radius	0.17	118	3.5

TABLE 13.—RADIOACTIVITY IN WATER

[Average concentrations in μμc/liter]

Period	Source of samples	Alpha	Nonvolatile beta	H^3	Sr^{90}
Third quarter 1961	Public water supplies	1.0	7	—	—
	Savannah River water				
	3 miles upstream	0.2	8	6,000	0.4
	10 miles downstream	0.3	17	11,000	0.6
Fourth quarter 1961	Public water supplies	1.1	9	—	—
	Savannah River water				
	3 miles upstream	0.3	9	4,000	0.4
	10 miles downstream	0.3	40	17,000	0.9

Conclusion

Radioactivity in the environs of the SRP during the third and fourth quarters of 1961 was primarily from weapons test fallout.

Previous coverage in Radiological Health Data:

Period covered	*Issue*
1959 and first quarter 1960	*December 1960*
Second and third quarters 1960	*May 1961*
Fourth quarter 1960	*August 1961*
First and second quarters 1961	*February 1962*

Strontium–90 in Animal Feeds
1961

Pharmacology Division
Food and Drug Administration

A part of the continuing surveillance of radioactivity in foods by the Food and Drug Administration is concerned with the levels of strontium–90 in animal feeds. The samples are analyzed in a manner similar to food items, as indicated in Section II of this issue. Data on strontium–90 in animal feeds appear in table 1.

The leafy types of animal feeds continue to show increased concentrations of strontium–90, as indicated by alfalfa. The influence of geography on strontium–90 levels in animal feeds is not clearly evident from the data in the table.

TABLE 1.—STRONTIUM–90 CONTENT OF ANIMAL FEEDS

Product	Origin			Harvest date	Strontium-90 (μμc/kg)
	Harvest region	State	County		
Grasses and hays:					
Alfalfa	4	Minn.	Wright	June 1961	320
	7	Ohio	Wood	July 15, 1961	239
	10	W. Va.	Jefferson	July 1961	365
	11	Pa.	York	July 1961	779
Clover	11	N. Y.	Erie	June 1961	506
[illegible] hay	9	S. C.	Orangeburg	Nov. 1961	82*
Rye	11	Pa.	Dauphin	Nov. 1961	297*
[illegible] hay	9	N. C.	Bladen	Oct. 1961	520*
			Halifax	Nov. 1961	845*
Soybean hay	9	Ga.	Peach	Nov. 1961	25*
		S. C.	Orangeburg	Nov. 1961	57*
[illegible]:					
Corn ensilage, wet basis	4	Minn.	Hennepin	Sept. 1961	32
	5	Mich.	Macomb	Sept. 15, 1961	18
				Oct. 12, 1961	9*
	10	N. J.	Sussex	Oct. 10, 1961	64*
Corn silage	9	Ga.	Hart	Aug. 1961	513
				Oct. 1961	63*
	10	Md.	Hartford	Oct. 1961	23*
	11	Pa.	Bucks	Sept. 1961	34
				Oct. 1961	18*
Cotton seed hulls	9	S. C.	10 counties	Sept. 1961	30
Cotton seed meal	3	Ariz.	Pinal	1961	2.9
	8, 9	Ala., Ga.	14 counties	1961	72
	9	Ga.	Jefferson	Nov. 1961	95*
		S. C.	10 counties	Sept. 1961	85
Dried beet pulp	4	Minn.	Renville	Oct. 1961	104*
Dried sugar beet pulp	1	Calif.	Solano, Yolo	Oct. 15, 1961	20*
	5	Mich.	Saginaw	Nov. 1, 1961	112*
	7	Ohio	Wood	Oct. 16, 1961	27*
Sorghum forage	9	Ga.	Hart	Aug. 1961	513

* Indicates harvested after September 15, 1961.

Reported Nuclear Detonations

August 1962

Summary information on nuclear detonations during the month preceding publication is regularly reported in this section of *RHD*. Attention is directed to the following omission from the April 1962 issue: On March 1, 1962, the United Kingdom and the United States jointly conducted a low yield underground test detonation at the Nevada Test Site.

The table below summarizes the available information on nuclear detonations conducted during August 1962. It will be observed that the numbering sequence for the U.S.S.R. detonations continues from their last definitely known test, which was reported in the March 1962 issue; however, the Atomic Energy Commission announced on August 6, 1962, that there were indications that the Soviet Union had resumed testing in the low yield range a few days prior to the test reported for August 5.

Test Number	Location	Date	Yield Range*	Type of Test
REPORTED U.S.S.R. DETONATIONS				
33	Novaya Zemlya	August 5, 1962	30 Megatons	Atmospheric
34	Central Siberia	August 7, 1962	Low yield	Atmospheric
35	Novaya Zemlya	August 10, 1962	Intermediate	Atmospheric
36	Novaya Zemlya	August 20, 1962	Low megaton	Atmospheric
37	Novaya Zemlya	August 22, 1962	Low megaton	Atmospheric
38	Novaya Zemlya	August 25, 1962	Low megaton	Atmospheric
39	Semipalatinsk	August 25, 1962	Low yield	Atmospheric
40	Novaya Zemlya	August 27, 1962	Low megaton	Atmospheric
REPORTED U. S. DETONATIONS				
77	Nevada Test Site	August 24, 1962	Low yield	Underground
78	Nevada Test Site	August 24, 1962	Low yield	Underground

* Low yield range has been announced as less than 20 kilotons yield; intermediate yield is in the range of 20 kilotons up to 1 megaton; and low megaton yield is in the range from 1 to several megatons.

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